BC Hydro
Power smart

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January 15, 2019

Mr. Patrick Wruck
Commission Secretary and Manager
Regulatory Support
British Columbia Utilities Commission
Suite 410, 900 Howe Street
Vancouver, BC V6Z 2N3

Dear Mr. Wruck:

RE: British Columbia Utilities Commission (BCUC or Commission)
British Columbia Hydro and Power Authority (BC Hydro)
2004/05 and 2005/06 Revenue Requirements Application
Commission Decision: Order No. G-96-04, October 29, 2004,
Directive 66 (page 197)

BC Hydro writes to submit its F2018 Demand Side Management Milestone Evaluation Summary Report (**the Report**), dated December 2018 and the final report for Evaluation of the Residential Inclining Block Rate: F2013-F2017 in compliance with Directive 66 (page 197) of the Commission Decision on BC Hydro's 2004/05 to 2005/06 Revenue Requirements Application, dated October 29, 2004. Directive 66 directs BC Hydro to file the executive summaries of its milestone evaluation reports and full final evaluation reports for all its Power Smart programs.

The Report summarizes the impact evaluations completed during F2018 for the following:

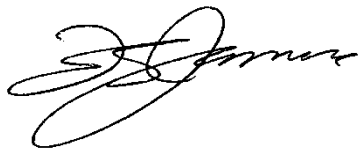
1. Residential General Service Lighting: F2012-F2017;
2. Low Income Program: F2011-F2016;
3. Power Smart Partner – Distribution Program: F2011-F2016;
4. Residential Inclining Block Rate: F2013-F2017; and
5. Residential Retail Program – Consumer Electronics and Appliance Rebate Offers: F2011 to Second Quarter F2015.

The findings from the attached final report for the Evaluation of the Residential Inclining Block Rate: F2013-F2017 show that structural savings in F2016 and F2017 were deemed to be small or zero. Accordingly, no new incremental savings are forecast for the Residential Inclining Block Rate in BC Hydro's Demand-Side Management Plan, and no further evaluations will be undertaken. BC Hydro is therefore filing the full report as

the final evaluation for the Residential Inclining Block Rate in compliance with Directive 66.

For further information, please contact Geoff Higgins at 604-623-4121 or by email at bchydroregulatorygroup@bchydro.com.

Yours sincerely,



Fred James
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Enclosure (1)

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Demand Side Management Milestone Evaluation Summary Report F2018

December 2018

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1 Introduction

This report summarizes the milestone evaluations of demand-side management (**DSM**) initiatives completed by BC Hydro in fiscal year 2018 (**F2018**). It is filed in compliance with Directive 66 of the British Columbia Utilities Commission (**BCUC**) decision on BC Hydro's F05/F06 Revenue Requirements Application (dated October 29, 2004), which "*directs BC Hydro to file the executive summaries of its milestone evaluation reports and full final evaluation reports of all its Power Smart programs*" (page 197).

BC Hydro evaluates its DSM initiatives to improve its estimates of realized DSM electricity savings and to improve their effectiveness and efficiency.

DSM evaluation activities are guided by the following six principles:

- Objectivity and Neutrality: Evaluations are to be objective and neutral.
- Professional Standards: Evaluation work is guided by industry standards and protocols.
- Qualified Practitioners: BC Hydro employs qualified staff and consultants to conduct evaluations.
- Appropriate Coverage: BC Hydro strives to achieve defined coverage levels for its evaluation of DSM initiatives.
- Business Integration: The evaluation function is integrated into BC Hydro's DSM business process of planning, implementation, reporting and evaluation.
- Coordination: BC Hydro evaluation work is coordinated with FortisBC and other DSM partners where feasible.

BC Hydro DSM evaluations are subject to an independent oversight process to ensure that they are neutral and unbiased, of sufficient quality for their intended purposes, and consistent with industry standards and protocols.

1.1 Completed Evaluations

Impact evaluations summarized in this report focused on the following:

- Residential General Service Lighting: F2012-F2017;
- Low Income Program: F2011-F2016;
- Power Smart Partner – Distribution Program: F2011-F2016;
- Residential Inclining Block Rate: F2013-F2017; and
- Residential Retail Program – Consumer Electronics and Appliance Rebate Offers: F2011 to Second Quarter F2015.

2 Residential General Service Lighting: F2012-F2017

2.1 Introduction

This market and impact evaluation examines changes in the market and in-home installation trends for residential lighting in British Columbia over the past six years. It also presents evaluated gross savings in the residential sector from the reduction in electricity usage of incandescent general service lamps (**GSL**) during a period of time that encompasses the introduction of energy efficiency regulations. Estimates of gross savings at industrial and commercial facilities are not included.

Phase 1 of British Columbia's GSL Regulation came into force on January 1, 2011. The GSL Regulation provided minimum energy performance standards for a range of medium base screw-type electric lamps, effectively banning 75 to 100 watt incandescent lamps. Phase 2 of the regulation came into force in January 2015 when national minimum energy performance standards for 40 to 60 watt general service lamps came into effect, which effectively banned 40 to 60 watt incandescent lamps.

BC Hydro includes gross electricity savings from the GSL Regulations in its reported and forecast DSM savings and in its load forecast after DSM.

2.2 Approach

Shown below are the evaluation objectives, research questions, data sources and methods.

Table 1 Evaluation Objectives and Research Questions

Objectives	Research Questions
1. Supply side analysis	a. What are shelf share trends by lamp type? b. What are price trends by lamp type? c. What is the level of retailer compliance with the regulation?
2. Demand side analysis	a. What are long-term trends in the types of lamps used in the home? b. How familiar are customers with various lighting products? c. How satisfied are customers with various lighting products? d. How many customers purchased and installed various lighting products? e. How many customers put various lighting products into storage?
3. Gross energy savings from conversion of incandescent la mps	a. How much conversion of 40, 60, 75 and 100 watt incandescent lamps to other lamp wattages occurred in the homes of BC Hydro customers between F2011 and F2017? b. What is the wattage of 40, 60, 75 and 100 watt replacement lamps? c. What are the gross energy savings associated with conversion of 40, 60, 75 and 100 watt lamps to other wattages? d. What are the reasons behind any variance between reported and evaluated gross savings?

Table 2 summarizes, for each of the evaluation objectives, the evaluation data and methods used.

Table 2 Evaluation Objectives, Data and Methods

Objectives	Data sources	Method
1. Supply side analysis	• Shelf space survey (n= approximately 40 stores per year for 7 years, from F2011 to F2017)	• Cross tabulations • Trend analysis
2. Demand side analysis	• Telephone surveys of residential customers for F2011, F2012 & F2013 (approximately 400 to 600 responses per survey) • Online surveys of residential customers for F2016 (888 responses) and F2017 (2,222 responses) • Residential End Use Surveys from F2002, F2004, F2007, F2009, F2011, F2013, F2015, F2017 (approximately 4,200 to 7,600 responses for the lighting section)	• Cross tabulations • Trend analysis
3. Gross energy savings from conversion of incandescent la mps	• F2011 residential monitoring study (48 homes audited) • F2014 residential audits (56 homes audited) • F2017 residential audits (233 homes audited) • Residential End Use Surveys from F2011, F2013, F2015 and F2017 • BC Hydro Annual Reports for F2011 to F2017 • BC Hydro Codes and Standards savings forecast as of spring 2017	• Engineering algorithms

Objective 1, related to supply side analysis, was completed using shelf space data. The lighting shelf space studies cover approximately 40 retail stores annually and collect a range of information on a census count of specific lighting products on the shelves of each store.

Objective 2, related to demand side analysis, was completed through cross tabulations and trends analysis of data from surveys of BC Hydro's customers. Lighting surveys collected data on consumer awareness of various lighting technologies, purchase and installation rates, satisfaction and other measures. Residential End Use Surveys collected detailed information about lighting products installed in the home.

Objective 3, related to gross savings, was completed using engineering algorithms with inputs from monitoring studies or home audits, Residential End Use Surveys and BC Hydro annual reports. The analysis involved seven steps: 1) estimate the total number of incandescent lamps installed in homes in each year of interest, 2) determine the distribution of incandescent lamp wattages installed in homes, 3) estimate the average number of incandescent lamps per home by wattage, 4) calculate the power draw of GSL replacement lamps, 5) identify hours of use and peak coincidence, 6) adjust for cross effects, and 7) calculate evaluated gross savings.

2.3 Results

Objective 1: Supply Side Analysis

The shelf space occupied by incandescent lamps dropped from 51 per cent in F2012 to 24 per cent in F2017. During this same period, shelf space occupied by LED lamps rose from 4 per cent to 40 per cent, taking over the largest share of shelf space in F2016. While compact fluorescent lamps (**CFLs**) had a fairly consistent shelf space share of about 25 per cent from F2012 to F2014, their share has steadily declined since then and reached 13 per cent in F2017. Halogen lamps have held fairly consistent shelf space since F2013, fluctuating between 17 per cent and 21 per cent.

Incandescent (60 watt A-shape) lamp prices have increased from an average of $0.85 in F2011 to $1.43 in F2017, while LED (A-shape) lamp prices have declined from an

average of $24.63 in F2011 to $8.97 in F2017. Prices for CFL (13 watt spiral) lamps were generally stable, while prices for halogen (A-shape) lamps fluctuated somewhat through the period.

Within incandescent shelf space, up to 28 per cent was stocked with potentially non-compliant lamps in F2017. Compliance with the GSL regulations may be higher than indicated by this figure because the shelf space study did not record all lamp features that would have exempted lamps from the regulations.

Satisfaction ratings were collected only for CFL and LED lamps and in select years only. Satisfaction with CFL lamps in F2011 (regular and specialty lamps combined), was high at 89 per cent. In F2012 and F2013, results were available for specialty CFLs only and satisfaction was somewhat lower at 79 per cent in F2012 and 72 per cent in F2013. Satisfaction with LED lamps was high at 85 per cent in F2012 and increased to 93 per cent in F2013.

Objective 2: Demand Side Analysis

- During the evaluation period, the average total number of lamps installed per home was fairly flat at approximately 38 until F2017 when the number increased to 39.8. Incandescent lamps decreased from 17.6 lamps in F2011 to 13.1 lamps in F2017. CFLs reached their peak in F2013 at an average of 9.9 lamps, but have since decreased to 8.1 lamps in F2017. Halogen lamps fluctuated somewhat over the period, increasing in the early years from a low of 5.1 in F2011 to a high of 6.1 in F2015, but decreased to 5.4 lamps in F2017. LEDs increased rapidly from an average of less than one lamp per home in F2011 to 8.8 lamps in F2017. Fluorescent tubes were relatively stable throughout the evaluation period at approximately three tubes per home, while other lamps decreased slightly from 2.5 to 1.6.
- Based on the F2016 BC Hydro Lighting Survey, awareness of all lamp types is high, with 92 per cent of customers aware of halogens, 93 per cent aware of LEDs, 96 per cent aware of CFLs and 98 per cent aware of incandescents. In terms of

purchases over the past year, the share of customers that purchased at least one incandescent lamp has been steadily declining in recent years (from 44 per cent in F2012 to 34 per cent in F2016), as has the average number purchased (from 11.0 in F2012 to 6.8 in F2016). In contrast, the share that purchased at least one LED lamp has been steadily increasing (from 7 per cent in F2011 to 35 per cent in F2016), as has the average number purchased (from 3.7 in F2011 to 8.3 in F2016). Although the percentage of customers reporting that they had at least one incandescent lamp in storage has remained relatively flat in recent years (between 58 per cent and 65 per cent), the average number of reported lamps in storage has decreased from 10.0 in F2012 to 6.8 in F2017. This translates into approximately 7.1 million incandescent lamps in storage across BC Hydro's service territory.

Objective 3: Evaluated Gross Energy Savings

During the evaluation period, the average number of incandescent lamps installed in homes decreased from 17.6 in F2011 to 13.1 in F2017. Since the introduction of the Phase 1 regulation, the average number of 75 to 100 watt lamps per home decreased from 2.8 to 1.1, with decreases in all wattage categories covered by the regulation. Looking at the pre- to post-regulation period for Phase 2 lamps (F2014 to F2017), there was an overall decrease from 12.1 to 11.0 regulated lamps installed in the home, but decreases were not seen across all wattage categories. Decreases were only observed for lamps in the 40 to <60 watt range, but increases were observed for lamps in the 60 to <75 watt range, which were also covered by the regulation.

The power draw of replacement lamps was estimated at 12.8 watts, based on a weighted average of CFL and LED wattages installed in the home in F2017.

Evaluated gross electric energy savings in residential homes from the changes in incandescent general service lighting were 251 GWh per year in F2017, or 37 per cent of reported savings. This was made up of 226 GWh per year among lamps affected by Phase 1 of the regulation and 25 GWh per year among lamps affected by Phase 2 of the regulation. Energy savings are expressed as an annual rate of savings in F2017 due

to changes since the identified baseline year (F2011 in the case of Phase 1 and F2014 in the case of Phase 2).

Table 3 Reported vs Evaluated Savings in F2017

		Energy Savings (GWh/year)		Peak Demand Savings (MW)
		Reported	Evaluated Gross	Evaluated Gross
F2017	Phase 1 lamps	300	226	75
	Phase 2 lamps	377	25	8
	Total	**677**	**251**	**83**

One of the main reasons for the variance between reported and evaluated savings, particularly for Phase 1 lamps, is a difference in assumptions used to estimate the number of regulated lamps in each of the wattage categories in F2011. Because the home audit data was not available when the reported savings model was first developed, it used shelf-space data to estimate the distribution of incandescent wattages, while this evaluation used the distribution of incandescent wattages based on home audits. The shelf-space method overestimated the relative share of 100 watt lamps and underestimated the relative share of 40 watt lamps as compared to the audit data.

The other main reason for the variance is that this evaluation found that the rate of replacement of incandescent lamps has been slower than assumed in reported savings, particularly for Phase 2 lamps. Reported savings assumed that by F2017, there would be a reduction of 15.8 million regulated lamps (approximately 5.1 million Phase 1 lamps and 10.7 million Phase 2 lamps, based on the wattage distributions from the shelf-space study). In contrast, this evaluation estimated that the reduction was in the range of 5 million lamps (approximately 3.1 million Phase 1 lamps and 1.9 million Phase 2 lamps, based on the wattage distributions from the home audits). This suggests that there are still a significant number of incandescent lamps to be replaced, and as the trend towards more efficient lighting continues, there are still significant savings to come in future years.

2.4 Findings and Recommendations

Findings

1. The shelf space of incandescent lamps has halved since F2012 (from 51 per cent to 24 per cent of total lighting shelf space), while the shelf space of LEDs has rapidly increased (from 4 per cent to 40 per cent), indicating that a shift towards energy efficient lighting has occurred in the market at the retail level.
2. The price of LEDs has been sharply declining in recent years, while the price for incandescents has been gradually increasing.
3. Within incandescent shelf space, the percentage that was stocked with potentially non-compliant lamps was estimated at a maximum of 28 per cent in F2017.
4. The number of incandescent lamps installed in the home has been decreasing steadily, while LEDs have been increasing rapidly. CFLs installed in the home appear to have peaked around F2013.
5. Although incandescent lamp purchases have declined over time, there are still a significant number of household purchasing them. In F2016, 34 per cent of households purchased at least one and among those that did, they purchased an average of 6.8 lamps.
6. Customers still have a high number of incandescent lamps in storage – an estimated 7.1 million across BC Hydro's service territory.
7. The average number of incandescent lamps installed in the home decreased from 17.6 to 13.1 between F2011 and F2017. As of F2017, there were an average of only 1.1 Phase 1 lamps remaining in the home, but still an average of 11.0 Phase 2 lamps.
8. Evaluated gross electric energy savings in residential homes from changes in general service lighting were 251 GWh/year in F2017, which was 37 per cent of reported savings.
9. The main sources of difference between reported and evaluated savings were assumptions about the baseline number of incandescent lamps by wattage

category and the rate of replacement of incandescent lamps. The home audit data was considered to be a better representation of installed incandescent wattages in the home compared to the shelf space data.

Recommendations

1. Consider collecting additional information on lamp characteristics in the shelf space studies in order to better estimate compliance. Consider encouraging government to increase enforcement efforts on regulated lamps if compliance is found to be low.
2. Evaluation and Codes & Standards staff should periodically share information with each other on available data that can inform estimates of reported and forecast savings.

2.5 Conclusions

There have been significant changes in the market for general service lamps between F2011 and F2017, with shifts occurring from incandescent to LED lamps, both on store shelves and installed in homes. However, the rate of replacement for incandescent lamps has been slower than anticipated and there remain a considerable number of 40 to 60 watt incandescent lamps still to be replaced. Evaluated gross savings are 37 per cent of reported.

3 Low Income Program: F2011-F2016

3.1 Introduction

The evaluation encompasses two Low Income Program offers over two separate time periods: Energy Saving Kits for the period April 2010 through March 2016 (ESK: F2011-F2016) and the Energy Conservation Assistance Program – Basic Offer for the period April 2011 through March 2016 Energy Conservation Assistance Program (**ECAP**) Basic: F2012-F2016).

The Low Income Program is a BC Hydro energy acquisition initiative to help income qualifying residential customers reduce their energy bills. During the evaluation period the program provided BC Hydro income qualifying residential customers with free energy efficient products and contractor-installed energy efficiency upgrades.

The program's key objectives were to:

- Make energy efficiency more accessible to low income customers by addressing the key barriers to energy efficiency in this sector (e.g., affordability, availability and awareness).
- Provide energy savings to BC Hydro through the installation of energy efficiency measures.
- Provide low-income customers with the opportunity to reduce their energy consumption and utility bills through energy efficiency improvements.
- Increase knowledge about energy conservation among low-income customers.

The Low Income Program launched in 2008 and has operated continuously since that time.

The scope of this evaluation includes the program's two largest offers: the Energy Saving Kit (**ESK**) and ECAP Basic. Two small offers were not evaluated: the Advanced Weatherization offer and the Apartment Direct Install offer. They accounted for 2 per cent and 1.5 per cent of the program's reported electricity savings, respectively,

over the evaluation period. They were not included in this evaluation for method reasons.[1]

The program was available to income qualifying residential customers. Statistics Canada's Low Income Cut Off (**LICO**) was used as the income qualification level prior to July 2014. On July 10, 2014 the income qualification level was raised to 1.3 times the LICO, and recipients of various government income and housing assistance programs were pre-qualified.[2]

The ESK is a package of basic, low-cost energy saving measures that can be installed by a homeowner or tenant. ESKs included items such as energy-efficient light bulbs, faucet aerators, window film and a refrigerator thermometer. Installation of the kit contents resulted in energy savings in lighting, space heating, and water heating.

The ECAP Basic offer was available to income qualified residential customers who lived in single family dwellings, duplexes, townhouses or mobile homes.[3] Eligible applicants received a basic home energy audit, installation of energy saving products, and education on energy saving actions from a contractor. The specific installations varied depending on the outcome of the basic audit, and included products to save on lighting, space heating and water heating. Some customers were also eligible for a refrigerator replacement.

3.2 Approach

Shown below are the evaluation objectives, research questions, data sources and methods.

1 Participation in Advanced Weatherization was too low to enable statistical analysis. Electricity consumption data was not available for a number of Apartment Direct Install participants.
2 BC Hydro 2015 Rate Design Application, Chapter 5.
3 Prior to December 2013 eligibility was also based on annual energy consumption.

Table 4 Evaluation Objectives and Research Questions

Objectives	Research Questions
1. Understand the program's target market and barriers to energy efficiency	• What are the characteristics of the population of eligible program participants? • What are the barriers to energy efficiency improvements among low income customers? • How are program participants different from the general population?
2. Assess the participant experience and measures installed through the ESK offer	• What was the installation rate by kit component? • How easy were the kit contents to install? • How satisfied were participants with the ESK offer? • Would participants have purchased most of these products on their own? • Would participants recommend the ESK to someone they know?
3. Assess the participant experience and measures installed through the ECAP Basic offer	• What measures were installed through the ECAP Basic offer? • How did participants learn about the ECAP Basic offer? • Did participants take additional energy savings actions as a result of participation in the ECAP Basic offer? • How satisfied were participants with the measures installed through ECAP Basic?
4. Estimate net electric energy and demand savings for the ESK and ECAP Basic offers	• What are the net electricity savings attributable to ESK by fiscal year? • What are the net electricity savings attributable to ECAP Basic by fiscal year?
5. Assess the effect of program participation on electricity bill payment performance	• How does participation in the Low Income Program impact the bill payment performance of participating homes?

Table 5 summarizes, for each of the evaluation objectives, the evaluation data and methods used.

Table 5 Evaluation Objectives, Data Sources and Methods

Objectives	Data sources	Method
1. Understand the program's target market and barriers to energy efficiency	• 2012, 2014 Residential End Use Survey • Statistics Canada • Literature review • BC Hydro 2015 Rate Design Application	• Qualitative research
2. Assess the participant experience and measures installed through the ESK offer	• 2014-2015 ESK Apartment Participant Survey (N=460) • 2014-2015 ESK House Participant Survey (N=544)	• Cross tabulations
3. Assess the participant experience and measures installed through the ECAP Basic offer	• 2014-2015 ECAP Participant Survey (N=722)	• Cross tabulations
4. Estimate net electric energy and demand savings for the ESK and ECAP Basic offers	• Electricity consumption data • BC Hydro account data • Program tracking data • Weather data	• Quasi-experimental design with variation in adoption • ANCOVA fixed effects modelling
5. Assess the effect of program participation on electricity bill payment performance	• Program tracking data • Creditworthiness score data • Electricity consumption data	• Quasi-experimental design • ANCOVA fixed effects modelling

The first objective, related to better understanding the program's target market and barriers to participation, was addressed through a review of Statistics Canada information and data collected through BC Hydro's Residential End-Use Surveys.

The second and third objectives, related to assessing the participant experience and measures installed through ESK and ECAP Basic, were addressed using the results of BC Hydro's ESK Apartment, ESK House and ECAP Participant Surveys. The surveys were optional and mailed in to BC Hydro by the program participants throughout most of 2014 and 2015.

The fourth objective, related to net savings, was addressed by conducting statistical analysis separately for ESK and ECAP Basic using electricity consumption and other data. The analysis involved quasi-experimental design with variation in adoption and

ANCOVA fixed effects modelling. This evaluation method produced a reliable estimate of average net savings per participant by fiscal year for both ESK and ECAP Basic.

The fifth objective, related to assessing the effect of program participation on electricity bill payment performance, was also addressed by conducting statistical analysis on creditworthiness scores. The analysis involved the same techniques as objective four.

The method for estimating net electric energy savings was used to provide some insights into savings persistence, the average daily shape of savings and savings seasonality. Peak demand savings were calculated using the evaluated savings shape.

3.3 Results

Objective 1: Understand the Program's Target Market and Barriers to Energy Efficiency

The prevalence of low income families in British Columbia has been higher than in Canada as a whole for more than a decade. The 2016 Census indicated that low income individuals make up 14.4 per cent of the population in British Columbia compared to the national average of 12.8 per cent.[4] The low income population is commonly made up of single parent families and persons not living in an economic family,[5] both elderly and non-elderly. Indigenous people, recent immigrants and persons living with a disability are also at higher risk of being low income compared to the rest of the population.

Members of these vulnerable groups face considerable challenges and barriers. Statistics Canada's LICO outlines the total household income required to qualify as low income, based on the number of occupants in the home. The LICO threshold captures both the very poor and the working poor. Approximately 70 per cent of Canadians living

[4] Statistics Canada, 2016 Census of Population, Statistics Canada Catalogue no. 98-400-X2016124. Accessed November 17, 2017.

[5] An economic family refers to a group of two or more persons who live in the same dwelling and are related to each other by blood, marriage, common-law, adoption, or a foster relationship.

in poverty (3.1 per cent of all Canadian families) are considered to be working poor.[6] The working poor typically have precarious employment situations (e.g., contract, part-time or temporary work); make minimum wage; have limited or no benefits; and have multiple jobs to cover basic living costs. They have no liquid assets or savings to draw upon, and may be dealing with inadequate housing conditions and food insecurity issues. These challenges can lead to the following barriers to low income households participating in energy efficiency improvements: 1) initial financial outlay required to purchase the measures, 2) duration of customer pay-back from bill saving due to energy efficiency measures, 3) high proportion of renters and, 4) tendency for higher household mobility among renters.

BC Hydro estimates that approximately 11 per cent of residential customers have household incomes below the LICO threshold. With the expansion of program eligibility in 2014 to 1.3 times the LICO, an estimated 21 per cent of residential customers became eligible for the program. From 2014 on, the expansion of the income qualification criteria contributed to a 23 per cent increase in program participation, implying that program participants after that date had higher average income levels than the general population of low-income customers, defined as below LICO.[7]

The energy consumption of ESK, ECAP Basic and all BC Hydro customers was also analysed and compared. The results showed that of the three groups, ECAP Basic participants spend the largest percentage of their income on electricity (4 to 10 per cent) as compared to ESK (2 to 8 per cent) and all customers (2.5 per cent or less) and have the highest electricity consumption per square foot.

6 Lefroncois, A. Canada's Working Poor and Precarious Employment. November 2015. Accessed October 18, 2017, http://www.livingwagecanada.ca/index.php/blog/canadas-working-poor-and-precarious-employment/.

7 BC Hydro 2015 Rate Design Application, Chapter 5, pages 5-76 and 5-77.

Objective 2: Assess the Participant Experience and Measures Installed through the ESK Offer

As noted above, data for this objective was collected through separate surveys of participants living in apartments and houses. However, there was minimal variation in survey responses by dwelling type so the results were combined.

The majority of respondents agreed or strongly agreed that the products were easy to install, that they were satisfied with the products received, and that they would recommend the kits to someone they know. On the five-point agreement scale, where one is "*strongly disagree*" and five is "*strongly agree*". Respondents averaged a score of 2.5 when asked whether they would have purchased most of the products on their own.

Reported installation rates were similar between apartments and houses. The highest installation rate was found for the LED night light and the fridge/freezer thermometer, at approximately 94 per cent. This was followed by the kitchen tap aerator (79 per cent) and CFL light bulbs (76 per cent). Between 41 to 45 per cent of participants living in apartments and houses did not install any window insulator film.[8]

Objective 3: Assess the Participant Experience and Measures Installed through the ECAP Basic Offer

Approximately 50 per cent of respondents learned about ECAP Basic through mail or bill inserts. Others learned about the program through avenues such as their property manager, online, through a friend or family member or from an ECAP representative. There was a mixed response when asked whether their household would have purchased and installed products on their own. Approximately 30 per cent agreed, 25 per cent neither agreed nor disagreed and 40 per cent disagreed. Around 80 per cent of respondents indicated that they had implemented additional energy savings actions since participating in ECAP Basic and the majority of respondents agreed or strongly agreed that they were satisfied with the products installed.

[8] During the program application process, participants could opt in to receive window film or not. This install rate includes participants that requested window film and did not install it, as well as those who requested no window film at all.

A review of program tracking data showed that the most commonly installed product categories were refrigerator thermometers and lighting products, which were installed by 96 per cent and 85 per cent of participating households, respectively. Between 40 to 60 per cent of participating households installed some type of draft-proofing or water heating measure, low flow shower heads, or carbon monoxide (**CO**) detectors. Refrigerators were replaced in about 21 per cent of participating households.

The average number of measures installed per home through ECAP Basic increased in F2013, most notably for lighting products, low flow faucets and CO detectors. The average number of measures installed per home remained relatively stable in subsequent years.

Objective 4: Net Electricity Savings for ESK and ECAP Basic

The evaluated and reported net savings by fiscal year are shown below. Evaluated savings are incremental annual savings.

Table 6 Summary of ESK and ECAP Basic Net Savings F2011-F2016

	Fiscal Year	Energy Savings (GWh/year)		Peak Demand Savings (MW)	
		Reported	Evaluated Net	Reported	Evaluated Net
ESK & ECAP Basic	F2011 (ESK only)	4.7	5.3	1.0	1.1
	F2012	5.9	5.2	1.2	1.0
	F2013	3.3	4.5	0.7	0.9
	F2014	3.5	4.2	0.7	0.8
	F2015	3.1	3.6	0.6	0.7
	F2016	2.8	4.3	0.6	0.9
Total		**23.3**	**27.0**	**4.8**	**5.5**

The results for F2011 include net savings for ESK only. F2011 savings for ECAP Basic were covered in a previous evaluation.[9]

Evaluated savings from both ESK and ECAP Basic were greater than reported savings. ESK evaluated savings totaled 19.7 GWh per year or 116 per cent of reported savings

[9] BC Hydro, 2012.

of 17.0 GWh per year. ECAP Basic evaluated savings totaled 7.3 GWh per year or 116 per cent of reported savings of 6.3 GWh per year. The variance is largely due to the evaluation finding that unit savings were higher than anticipated in most years of the evaluation timeframe.

As noted in the introduction, electricity savings from the program's Advanced Weatherization and Apartment Direct Install offers were not included in the scope of this evaluation and are therefore not included in the evaluated savings.

Objective 5: Assess the Effect of Program Participation on Electricity Bill Payment Performance

Statistical analysis on a subset of program participants (those who installed both an ESK and participated in ECAP Basic) revealed improvements in electricity bill payment performance among those who had a history of late payment prior to participating in the program. On average, the creditworthiness scores of F2013 ECAP Basic program participants who previously installed an ESK and who had at least some late payments in F2012 declined (improved) by 56 per cent in F2014. This means that for these participants, the program had a statistically significant influence on their ability or willingness to pay their bills in full and on time. This evaluation did not examine whether a similar outcome would be achieved by customers who participated in other offers or initiatives (e.g., ESK only), or by customers with different demographic or other characteristics than those who were analyzed.

3.4 Findings and Recommendations

Findings

Below are the evaluation findings.

1. The prevalence of low income households is higher in BC than the rest of Canada, and is slightly higher in the Lower Mainland than the rest of BC.
2. Barriers to low income customers participating in energy efficiency improvements include the cost of energy saving products or measures, a rental situation denying

them authority or incentive to invest in energy efficiency and a higher level of household mobility.

3. The large majority of 2014 and 2015 participants found the ESK products easy to install, were satisfied with the products and would recommend the ESK to someone they knew.
4. The large majority of 2014 and 2015 ECAP participants were satisfied with the products installed and have taken additional steps to save energy since the measures were installed.
5. Between F2011-F2016, 70,475 homes registered for an ESK.
6. On average, between F2011 and F2016, ESK participants saved between 262 and 316 kWh per year per home with each kit installed. These averages apply across all regions, building types, and space and water heating fuels.
7. Analysis of F2011 ESK participants living in owned, single family dwellings in the Lower Mainland found that ESK measures saved 752 kWh per year in electric space heating, 496 kWh per year in electric water heating and 159 kWh per year in other end-uses.
8. ESK evaluated net savings between F2011 and F2016 were 19.7 GWh per year, which equates to 116 per cent of what was reported.
9. Between F2012-F2016, 9,358 homes were verified as having installed measures through ECAP Basic.
10. On average, between F2012 and F2016, ECAP Basic participants saved between 642 and 899 kWh per year per home. These averages apply across all regions, building types, and space and water heating fuels.
11. ECAP Basic evaluated net savings between F2012 and F2016 were 7.3 GWh per year, which equates to 116 per cent of what was reported.

12. The evaluated net savings for both ESK and ECAP Basic over the evaluation period was 27.0 GWh per year, which equates to 116 per cent of what was reported.
13. The average ESK unit savings in multi-unit buildings serviced by a single BC Hydro meter could not be estimated due to insufficient data.
14. Among ECAP Basic program participants in F2013 who had at least one late electricity bill payment prior to participating in the program, there was an average 56 per cent reduction (improvement) in their BC Hydro creditworthiness scores between F2012 and F2014. This indicates that among those who participated in both ESK and ECAP Basic, the program had a statistically significant influence on the ability or willingness to pay their bills on time and in full.
15. BC Hydro does not systematically archive creditworthiness score data for residential customers and this limits the ability to analyze the program's impact on bill payment performance.
16. The evaluation required extensive time to clean the program tracking data and understand the impact of program changes on the data over time which could be reduced through changes to data management practices.

Recommendations

Below are the evaluation recommendations. Recommendations 1 through 5 are for program management. Recommendation 6 is for evaluation.

1. Consider continuing to deliver periodic customer surveys if there is an interest in understanding changes in customer satisfaction and measure installation rates over time.
2. In the case of multi-unit residential building where all units share one BC Hydro account and only a portion of residents participate in the program, consider collecting information on all units in the building to increase the feasibility of evaluating this group in the future.

3. Consider systematic archiving of selected creditworthiness score data in order to support future analysis of the program's impact on the bill payment performance of income qualifying residential customers.
4. Continue to seek out opportunities to improve data quality. Actions may include, removing unused data fields in the program tracking data, creating a drop down menu for applicable information fields, developing a data dictionary and reviewing the process for crosschecking customer account ID's against the BC Hydro billing system.
5. Document relevant program changes over time in order to facilitate future evaluations.
6. Determine whether there is a need or interest in further delineation of program savings (e.g., by space or water heating fuel or by building type) to inform evaluation planning going forward.

3.5 Conclusions

The majority of Low Income Program participants were satisfied with the measures installed through the program.

The Low Income Program was successful in achieving electric energy savings among BC Hydro's low income customers. Evaluated net savings were 27.0 GWh per year by the end of F2016, which was 116 per cent of what was reported.

There is evidence to suggest that participation in both ESK and ECAP Basic influenced the electricity bill payment performance of income qualifying customers who had a history of late electricity bill payment prior to participating.

4 Power Smart Partner – Distribution Program: F2011-F2016

4.1 Introduction

This is an impact evaluation of BC Hydro's Power Smart Partner – Distribution (**PSP-D**) DSM program for BC Hydro fiscal years F2011 to F2016 (April 2010 to March 2016). This evaluation also includes elements of a process and market evaluation for the period F2011 to F2016.

BC Hydro's PSP-D program (renamed Leaders in Energy Management – Distribution in F2016) is a multi-year energy acquisition and market transformation initiative that encourages industrial customers that receive electricity supply at distribution voltage to reduce their electricity consumption. The program's target market is BC Hydro's industrial customer sites that are serviced at distribution voltage (< 69 kV). The key program objective during the period evaluated was to partner with program participants to obtain cost-effective electricity savings from capital projects by encouraging them to integrate energy efficiency into their on-going business practices and supporting the development and implementation of energy management systems.

The scope of this evaluation includes electrical energy efficiency and conservation projects at industrial distribution sites, including retrofit and new plant design and plant expansion projects, but excluding operational and procedural measures not supported by a formal sustainment plan. This encompasses the incentive offer and enabling activities, as further described below. During the six-year evaluation timeframe, 2,215 energy efficiency and conservation projects were completed at 767 participating customer sites and reported under the program. Program participants included the following industrial segments: wood, manufacturing, food and beverage, transportation and oil and gas. Similarly, the program reported projects in various end uses with a primary focus in lighting, compressed air and industrial processes.

The main program components and enabling activities in PSP-D F2011-F2016 are summarized below:

- **Custom Projects**
  - Incentives**:** Incentives of up to 75 per cent of project costs were available for custom projects.
  - Program Enabled**:** Customer-funded projects that did not receive direct capital incentive funding but were reported as a result of other program enabling activities.
- **Prescriptive incentives**: Since F2014, smaller lighting and compressed air projects were also eligible for prescriptive incentives under the self-serve incentive program (**SIP**). The Product Incentive Program (**PIP**) and Power Smart Express (**PSX**) were prescriptive programs for customers that consume less than 0.5 GWh per year and offered incentives for simple, one-for-one lighting retrofits.
- **BC Hydro Key Account Managers:** Acted as a liaison between the program and the customer.
- **BC Hydro Alliance of Energy Services Professional (formerly known as the Power Smart Alliance):** Trained and pre-qualified trade allies offering energy efficiency products and services to BC Hydro customers.
- **Energy Studies:** To identify and support a business case for implementation of energy conservation measures. Partially or fully funded by BC Hydro.
- **Energy Managers:** Helped participants adopt strategic energy management practices. Partially funded by BC Hydro.

4.2 Approach

The evaluation objectives and research questions are shown below, followed by the data sources and methods.

Table 7 Evaluation Objectives and Research Questions

Evaluation Objective	Research Questions
1. Assess participant and non-participant experience and satisfaction	What is the participant and non-participant experience related to awareness, understanding, and satisfaction with the various program offers (custom incentive, program enabled, new plant design, prescriptive incentive)? What are the barriers to and drivers of program participation?
2. Assess the program enabling activities	What proportion of the savings came from sites with a BC Hydro funded Energy Manager over time? What is the relationship between presence of energy managers and project activity? Which of the enabling activities had the greatest association with project activity, in general and over time? What could be done to improve the evaluability of the program enabling activities?
3. Estimate gross electrical energy and peak demand savings	What were the gross realization rates by end use? What were the evaluated gross energy and demand savings realized by the PSP-D program, delineated by fiscal year and by offer to the extent possible?
4. Estimate net electrical energy and peak demand savings	What are the evaluated net energy savings and demand savings realized by the PSP-D program, delineated by fiscal year and by offer to the extent possible? What factors impact free ridership among custom and prescriptive projects? How much free ridership occurred among custom and prescriptive projects? How much participant and non-participant spillover occurred in response to the program offers?

Table 8 Evaluation Objectives, Data and Methods

Evaluation Objectives	Data	Method
1. Assess participant and non-participant experience and satisfaction	• 6 waves of participant surveys covering F2011 to F2016 (n=328) • 2 waves of non-participant surveys covering F2011 to F2015 (n=206)	• Cross tabulations
2. Assess the program enabling activities	• Program tracking data	• Cross tabulations • Qualitative analysis
3. Estimate gross electrical energy and peak demand savings	• Program tracking data • Project files • Measurement and Verification results (n=297 measures) • Evaluation Review results (n=20 measures)	• Engineering calculation for measure evaluation review • Extrapolation of Measurement and Verification and Evaluation Review results using stratified ratio estimation • Rate class average peak-to-energy factor
4. Estimate net electrical energy and peak demand savings	• Results of Objective 3 • Project files • Participant survey (n=328 responses covering 341 projects) • Non-participant survey (n=206) • Case studies (n=40 projects)	• Triangulation of case study and survey based free ridership estimates • Survey based spillover algorithm • Rate class average peak-to-energy factor

4.3 Results

Objective 1: Participant and Non-Participant Experience and Satisfaction

Awareness of BC Hydro's conservation programs for industrial customers was highest among custom participants (87 per cent) and non-participants (84 per cent), as well as among SIP participants with a Key Account Manager (**KAM**) (85 per cent). Awareness was somewhat lower for SIP participants without a KAM (78 per cent), SIP non-participants (77 per cent) and Product Incentive Program or Power Smart Express (PIP/PSX) participants (79 per cent), and much lower for PIP/PSX non-participants (52 per cent). In terms of individual program components, understanding and overall ratings were highest for the role that KAMs play as liaisons of the program and the incentive structures for the SIP and custom offers.

Overall satisfaction with the custom and SIP offers was very high with 94 per cent of custom participants, 93 per cent of SIP participants with a KAM, and 91 per cent of SIP participants without a KAM rating it as excellent or good. Satisfaction was somewhat

lower for PIP/PSX participants at 83 per cent. In terms of program experience, service provided by contractors and suppliers/distributors rated highly among all participant groups, as did service provided by BC Hydro personnel among those customers with a KAM. Areas which rated lowest included direct mail/email about the program (for all offers), length of time to receive project approval (for the custom incentive offer), length of time to receive incentive (for the custom incentive offer), information about the program on the website (for the SIP offer), variety of products funded by the program (for SIP and PIP/PSX) and usability of the online application (for PIP/PSX).

Among all participant and non-participant groups, the factors that emerged as the greatest motivators to conserve electricity were making operating costs as low as possible, the overall level of electricity prices, a focus on cost cutting measures due to the economic downturn or conditions, and to benefit the environment. Among participants, the individual program offers also emerged as motivators. The largest barriers to conserving electricity were lack of funds for energy efficient retrofits, other operational priorities, and a lack of financial incentives for conservation programs. Among non-participants, the main reasons for not participating in the PSP-D program were that the benefits were not worth it, the customer needed more information, and the customer thought the organization was not eligible to participate.

Objective 2: Assess the program enabling activities

Program enabling activities provided participants with a suite of tools and offers intended to help them to implement energy saving projects while also building energy management activities into their standard business practices over the long term. The tools and offers included funding for an energy manager position, energy efficiency feasibility studies, customer site investigations and plant-wide audits, end use assessments, as well as the support and expert consultation from the BC Hydro Alliance.

The evidence reviewed for this evaluation indicates that energy managers played an important role in program participation. During the evaluation period, sites with energy managers completed more than twice as many projects per site relative to those without

energy managers (on average, 2.7 projects versus 1.2 projects). Also, the relative level of project savings (as a per cent of site energy consumption) was twice as high at sites with energy managers than at sites without an energy manager for small and large sites based on site energy consumption during the evaluation period.

Under the program's custom offer, 25 per cent of the projects implemented during the evaluation period, and 43 per cent of the expected energy savings, were supported by a program-funded energy study. Similarly, 34 per cent of the projects and 43 per cent of the expected energy savings were supported by a program-funded energy manager. Further, 72 per cent of expected energy savings were supported by either an energy study or an energy manager, indicating that most sites participated in either the energy manager or energy study program enabling activity but not both. Sixty per cent of energy savings occurred at sites that had previously participated in one of the program's enabling activities.

Objective 3: Estimate gross electrical energy and peak demand savings

Evaluated gross energy savings provide an estimate of savings achieved at participating sites, irrespective of whether they are attributable to the program. Evaluated gross savings are estimated by applying a realization rate derived from measurement and verification results to the expected savings by end use measure. The three samples of end use measures that were evaluated were lighting, compressed air and other end uses with realization rates and evaluated gross energy savings of 101 per cent (122 GWh/year), 112 per cent (43 GWh/year), and 89 per cent (55 GWh/year) respectively. An overall realization rate of 99 per cent was calculated for the entire program in the evaluation period, indicating that, on average, projects supported by the program achieved their expected savings. Evaluated gross energy savings averaged 8.5 per cent of site energy consumption across all participants during the six year evaluation period.

Table 9 Summary of Gross Energy and Peak Demand Savings

Period	Number of Measures	Energy Savings (GWh/year)		Peak Demand Savings (MW)
		Expected Gross	Evaluated Gross	Evaluated Gross
F2011	579	43.7	44.2	6.0
F2012	806	34.4	36.4	4.9
F2013	733	40.1	38.1	5.2
F2014	521	27.5	27.1	3.7
F2015	534	44.7	43.5	5.9
F2016	550	30.9	30.6	4.2

Objective 4: Estimation of Net Electricity Savings

Net electricity savings are the change in energy consumption and demand that is attributable to the program. They exclude free riders and include spillover. Free ridership provides an estimate of the proportion of evaluated gross energy savings that are not attributable to the program. Free ridership was estimated separately for the three types of projects reported by the program: custom, SIP and PIP/PSX with estimated free ridership of 14 per cent, 12 per cent and 18 per cent respectively. Spillover savings are additional savings that occurred due to the program's influence. Spillover was estimated at 11 per cent for the overall evaluation period among participants and non-participants. An overall net to gross ratio of 97 per cent was calculated for the entire program in the evaluation period. Evaluated net energy and peak demand savings are shown in Table 10 and average 108 per cent of reported savings, showing that the program performed better than reported.

Table 10 Summary of Net Energy and Peak Demand Savings

	Energy Savings (GWh/year)		Peak Demand Savings (MW)	
Period	Reported	Evaluated Net	Reported	Evaluated Net
F2011	41.9	43.1	5.7	5.9
F2012	31.2	35.3	4.2	4.8
F2013	35.9	36.8	4.9	5.0
F2014	23.6	26.1	3.2	3.5
F2015	37.8	41.9	5.1	5.7
F2016	27.2	29.6	3.7	4.0

The variance between reported and evaluated net savings is primarily due to the evaluated net to gross ratio being higher than what was assumed for reported savings.

4.4 Findings and Recommendations

Findings

1. Awareness of the PSP-D offers was highest among custom participants and non-participants, as well as SIP participants with a KAM. In terms of individual program components, awareness was highest for energy studies and the role that KAMs play as liaisons for the program.
2. Overall satisfaction with the custom and SIP offers was very high with over 90 per cent of participants rating these offers as excellent or good. Satisfaction was lower among PIP/PSX participants at 83 per cent.
3. Over 80 per cent of the program enabled projects (62 per cent of gross energy savings) reported through the program came from sites with an energy manager.
4. Overall, when comparing sites of similar size, the sites with energy managers completed more projects and achieved more energy savings per project. The relative level of project savings (as a per cent of site energy consumption) was twice as high at sites with energy managers than at sites without: 10 per cent versus 5 per cent for sites with energy consumption higher than 4 GWh/year, and

24 per cent versus 12 per cent for sites with energy consumption less than 4 GWh/year.

5. Forty-six per cent of the program's energy savings were supported by either or both of an energy manager or energy study. Sixty per cent of the program's energy savings occurred at sites that had previously participated in program enabling activities.

6. The lack of a standardized process for tracking customers' program enabling activities in project files made it difficult to identify and assess the influence of individual enabling activities on the project's energy savings unless the case study method was applied during evaluation.

7. The program gross realization rate calculated from M&V results was 99 per cent, indicating that the energy conservation measures largely performed as expected. Three end use level realization rates were estimated: compressed air at 112 per cent, lighting at 101 per cent and other end uses at 89 per cent with relative precision between 6 per cent and 9 per cent at 90 per cent confidence.

8. Expected energy savings averaged 8.5 per cent of site energy consumption across all participants during the six year evaluation period.

9. The average weighted persistence of measures (i.e., the length of time that the savings are reported by the program) was 13.1 years during the evaluation period.

10. The net-to-gross ratio was 97 per cent based on an overall level of free ridership of 14 per cent, participant spillover of 7 per cent and non-participant spillover of 4 per cent.

11. Evaluated net savings during the evaluation period from F2011 to F2016 averaged 108 per cent of reported savings.

Recommendations

Recommendation 1 is for program management and Recommendations 2 and 3 are for future evaluations.

1. In consultation with the Evaluation Department, consider ways to improve the evaluability of the program enabling activities through improved documentation and tracking of energy savings opportunities identified and level of influence of program enabling activities.
2. Consider using a greater sample of case studies to assess influence of program enabling activities on custom projects.
3. Should future evaluations use top-down statistical analysis of facility consumption to estimate savings from Strategic Energy Management, review the approach to evaluating participant spillover to ensure there is no double counting of savings.

4.5 Conclusions

BC Hydro's Power Smart Partner – Distribution program achieved 108 per cent of reported savings during fiscal years F2011 to F2016. The program also achieved high levels of customer awareness and satisfaction.

5 Residential Inclining Block Rate: F2013-F2017

5.1 Introduction

The Residential Inclining Block (**RIB**) rate is a two-step rate structure where BC Hydro's residential customers pay a lower price for electricity consumption up to a certain threshold, and a higher price for electricity consumption beyond the threshold.

The RIB rate went into effect in October 2008 for approximately 1.6 million residential customers. The Step 1 to Step 2 threshold was set at 1,350 kWh per two-month billing period, which was approximately 90 per cent of the median consumption of BC Hydro's residential customers. The Step 2 rate was established at BC Hydro's current estimate of the cost of new energy supply, grossed up for losses, and the Step 1 rate was calculated to achieve revenue neutrality for the residential class. The over-arching objective of the RIB rate was to use price to encourage additional electricity conservation relative to what was achievable through a flat rate structure.

The last evaluation of the RIB rate was conducted in 2013[10] and evaluated the price elasticity of consumption and the electricity conservation impacts in response to the rate's two-step structure, as well as customer awareness, understanding, and response to the RIB rate for the period from October 2008 through March 2012 (the mid-point of F2009 through F2012). This evaluation is a continuation of the 2013 evaluation, and covers April 2012 through March 2017 (F2013-F2017).

5.2 Approach

The evaluation objectives and research questions are shown on the following page.

[10] BC Hydro (2014) "Evaluation of the Residential Inclining Block Rate F2009-F2012", Revision 2, Power Smart Evaluation, BC Hydro.

Table 11 Evaluation Objectives and Research Questions

Objectives	Research Questions
1. Estimate Price Elasticity	• What is the price elasticity of Step 1 and Step 2 consumption? • Is there a difference in price elasticity between BCH customers and a comparable community without a RIB rate (e.g., New Westminster)? • What is the price elasticity due to natural conservation, as measured by the price response to general rate increases through F2017? • How do the results of research questions related to price elasticity compare to previous research on this topic conducted as part of the last RIB rate evaluation?
2. Estimate the Conservation Impacts of the RIB Rate	• What are the energy savings due to BC Hydro's RIB Rate from F2013 to F2017? • What are the peak demand savings due to BC Hydro's RIB rate from F2013 to F2017? • What are the energy savings due to natural conservation from F2013 to F2017, as measured by the price response to general rate increases?
3. Analyze Differences in Price Elasticity by Customer Characteristics	• Are there differences in price elasticity by region? • Are there differences in price elasticity by dwelling type? • Are there differences in price elasticity by space heating type? • How do the results of research questions related to price elasticity compare to previous research on this topic conducted as part of the last RIB rate evaluation? • Are there differences in price elasticity between winter and summer periods?
4. Evaluate the Customer Response and Understanding of the RIB Rate	• Are there differences in the characteristics or demographics of customers who are never billed in Step 2 compared to those who are sometimes or always billed in Step 2? • What is the level of customer awareness and understanding of the RIB rate? • To what degree do customers believe electricity prices provide an incentive to manage electricity consumption? • To what extent do customers believe the total electricity bill amount provides an incentive to manage electricity consumption? • What is customers' understanding of their prevailing electricity price under the RIB rate structure? • To what extent do customers believe the RIB provides an incentive to manage electricity consumption? • To what extent do RIB aware customers report energy conserving behaviours as compared to non-RIB aware customers? • To what extent do RIB aware customers report implementing longer term capital investment in energy efficiency or conservation as compared to non-RIB aware customers? • Was program participation in DSM programs different between customers aware / not aware of the RIB rate? • Did low income customers have a different perception or response to the RIB Rate? • Does the RIB rate have any impact on customers' decisions on fuel switching from electricity to thermal fuels? • Is the RIB rate perceived as a barrier to electrification? • Has customers' response/acceptance to RIB changed over time? • Do customers support the RIB rate? • Do notifications / alerts on Step 2 have an impact on customers' consumption behaviour? • How do the results of research questions related to customer response and understanding of the RIB rate compare to previous research on this topic completed as part of the last RIB rate evaluation or REUS surveys?

The table below summarizes the data sources and methods employed in this study for each evaluation objective.

Table 12 Summary of Evaluation Objectives, Data Sources and Methods

Evaluation Objective	Data Sources	Methods
1. Estimate Price Elasticity	• BC Hydro billing data from April 2004 to December 2016, including electricity consumption, space heating fuel, region and dwelling type by account • BC Hydro residential rate prices from April 2004 to December 2016 • BC Hydro DSM expenditures and savings, from 2004 to 2017 • BC Consumer Price Index data from April 2004 to December 2016 obtained from Statistics Canada • BC real disposable income from April 2004 to December 2016 from BC Stats • Heating and cooling degree days by region from April 2004 to December 2016 • New Westminster customer billing data from 2005 to 2016 and customer information on heating fuel and dwelling type	• Econometric modelling of price elasticity
2. Estimate the Conservation Impacts of the RIB Rate	• Data and results from Objective 1 • BC Hydro residential rate class load shape	• Calculation based on price elasticity and rate class load shape
3. Analyze Differences in Price Elasticity by Customer Characteristics	• Same as Objective 1	• Same as Objective 1
4. Evaluate the Customer Response and Understanding of the RIB Rate	• 2012 customer survey (n = 2,468) • 2017 customer survey (n = 3,307) • 2014 Residential End-Use Study (n=7,318) • 2017 Residential End-Use Study (n=6,929) • BC Hydro billing data from F2012 and F2017 • Data on customer sign-ups for Step 2 alerts • BC Hydro residential DSM program tracking data	• Cross tabulations of survey responses • Linking of survey responses to respondent billing history • Difference in proportions z-tests • Difference of Means Tests using Analysis of Variance

Objective 1, estimating price elasticity, and Objective 3, analyzing elasticities differences by customer characteristics, were addressed through econometric modeling which utilized a variety of data sources including electricity consumption and Statistics Canada data. Objective 2 was a calculation using the results from Objective 1.

Objective 4, related to evaluating customer response and understanding of the RIB rate, was largely addressed through analysis and comparison of the results from two similar residential customer surveys which were delivered in 2012 and 2017.

5.3 Results

Objective 1: Price Elasticity

Step 1 consumption represents the consumption of those customers whose bi-monthly usage does not exceed the 1,350 kWh threshold. The Step 1 price elasticity of these customers was estimated to be -0.14. The previous RIB evaluation in 2013 was unable to detect a Step 1 price elasticity over the F2009 to F2012 period, nor did a subsequent analysis over the F2009 to F2015 period. Due to the fact that Step 1 price elasticity could not be detected for the F2009 to F2015 period, the estimate of -0.14 was only seen to be applicable to F2016 and F2017.

Step 2 consumption represents the consumption of those customers whose bi-monthly usage exceeds the 1,350 kWh threshold. The Step 2 price elasticity of these customers was estimated to be -0.08, which is at the low end of the range estimate of -0.08 to -0.13 from the 2013 evaluation. The current estimate indicates that in comparison to the earlier years of the RIB rate, customers who were exposed to Step 2 prices in recent years may have become less price responsive—measured by percentage change in consumption—to Step 2 price increases. It also indicates that their capacity and options to conserve energy while facing price increases may have been more limited in recent years. Meanwhile, Step 1 consumption has become price sensitive in recent years.

Table 13 Step 1 and Step 2 Price Elasticity Estimates

Time Series Analyzed	Step 1 Elasticity	Step 2 Elasticity
F2005-F2012	Not statistically significant	-0.08 to -0.13***[11]
F2005-F2015[12]	Not statistically significant	Not analyzed
F2005-F2017	-0.14***	-0.08***

*** indicates statistically significant at 95% confidence level.

The price elasticity of electricity consumption under a flat rate is used to calculate the natural conservation impact that would be achieved by general rate increases as per BC Hydro's approved Revenue Requirements. This flat rate price elasticity is used to estimate the baseline conservation that would have occurred in the absence of the RIB rate. The flat rate price elasticity could not be estimated through econometric analysis. A range estimate between the Step 1 and Step 2 elasticities was adopted (-0.08 to -0.14) to calculate the natural conservation impact. Since the Step 1 price elasticity estimate of -0.14 was only applicable to F2016 and F2017, the range estimate of the flat rate elasticity was similarly applied to F2016 and F2017 only. In the absence of an empirical estimate of flat rate elasticity in the F2013 to F2015 period, the planning assumption of -0.05[13] was applied to those years.

Objective 2: Conservation Impacts of the RIB Rate

In order to evaluate additional energy conservation achieved under the RIB rate relative to the flat rate, the energy impacts of the Step 1, Step 2, and the flat rate price response were calculated separately. The baseline scenario was considered natural conservation achieved under the flat rate due to general rate increases and the RIB rate structural savings were calculated as the sum of the Step 1 and Step 2 energy impact, less the natural conservation impact. The annual incremental structural savings from the RIB rate between F2013 and F2015 are presented below. The calculations are based on the

[11] BC Hydro (2014).

[12] In 2016, an analysis was conducted to evaluate the Step 1 price elasticity for the period of F2005-F2015. This analysis did not produce statistically significant results. The modelling outputs from this analysis were included in Appendix D.

[13] Orans, R (2008), the source and reasons for adopting this assumption were provided in the expert testimony of the 2008 BC Hydro Long-Term Acquisition Plan, Appendix E.

value of Step 1 elasticity (zero), Step 2 elasticity (-0.08) and assumed flat rate elasticity (-0.05).

Table 14 RIB Rate Savings F2013-F2015

Fiscal Year	Step 1 Price Impact (GWh)	Step 2 Price Impact (GWh)	Natural Conservationz (GWh)	RIB Structural Savings (GWh)
	A	B	C	(A + B - C)
Elasticity	**0.00**	**-0.08**	**-0.05**	**-**
F2013	-	49	24	23
F2014	-	16	13	3
F2015	-	74	62	13

Given the potential range in flat rate elasticity (-0.08 to -0.14; assuming that it lies between the estimates of Step 1 and Step 2 elasticity), natural conservation and RIB structural savings in F2016 and F2017 could not be estimated with precision. Table 15 shows the calculation of natural conservation and RIB structural savings using four different flat rate elasticities: -0.08, -0.09, -0.10 and -0.14. Based on this calculation, savings appear to decrease as flat rate elasticity increases. Based on the results derived through the range estimate, the evaluated RIB energy savings in F2016 and F2017 were deemed to be small or zero, as shown in Table 16 below.

Table 15 RIB Rate Savings F2016-F2017

	Step 1 Price Impact (GWh)	Step 2 Price Impact (GWh)	Natural Conservation (GWh)				RIB Structural Savings (GWh)			
	A	B	C				(A + B- C)			
Elasticity	**-0.14**	**-0.08**	**-0.08**	**-0.09**	**-0.10**	**-0.14**	**-0.08**	**-0.09**	**-0.10**	**-0.14**
F2016	26	45	60	67	75	104	11	4	(3)	(33)
F2017	13	23	29	33	37	52	6	2	(2)	(16)

Based on the estimates of Step 1 (-0.14), Step 2 (-0.08), and the adopted flat rate elasticity range (-0.08 to -0.014) , the energy and peak demand saving impacts attributed to the RIB rate were calculated as presented in the table below.

Table 16 Reported and Evaluated RIB Rate Savings

	Energy Savings (GWh)		Peak Demand Savings (MW)	
Fiscal Year	**Reported**	**Evaluated**	**Reported**	**Evaluated**
F2013	42	23	9	5
F2014	19	3	4	1
F2015	59	13	12	3
F2016	29	0 to 11	6	0 to 2
F2017	8	0 to 6	2	0 to 1

Two major factors contribute to the variance between reported and evaluated RIB rate savings. First, the Step 2 price elasticity of -0.08 was smaller (in absolute value) than the planning assumption of -0.1. Second, the flat rate elasticity range estimate applied to F2016 and F2017 was higher (in absolute value) than the value used in the forecast of RIB savings (-0.05).

Objective 3: Price Elasticity by Customer Characteristics

Additional analyses were conducted to determine if separate price elasticity estimates could be identified based on season or specific customer characteristics such as region, dwelling type, and space heating fuel. Those results are presented in Table 17, where each category (region, dwelling type, space heating, winter vs summer) shows the results of a separate regression analysis. The results included in Table 17 show that Step 1 and Step 2 price elasticity varied by region, dwelling type, space heating type and winter versus summer. In some instances, the elasticity estimate was not statistically significant.

Table 17 Step 1 and Step 2 Price Elasticity by Customer Characteristics

Customer Segment	Step 1 Elasticity	Step 2 Elasticity
Region		
Lower Mainland	-0.22***	Not statistically significant
Vancouver Island	-0.18***	-0.12***
Southern Interior	Not statistically significant	Not statistically significant
North	-0.23***	Not statistically significant
Dwelling Type		
Single Family Dwelling	-0.04***	-0.08***
Row/Townhouse	-0.14***	-0.10***
Apartment	-0.26***	-0.07***
Mobile Home	-0.12***	-0.09***
Space Heating		
Electric	-0.11***	Not statistically significant
Non-Electric	-0.18***	-0.17***
Winter vs. Summer	Not statistically significant	More negative by 0.05 in winter than in summer (e.g., if summer price elasticity is -0.07, winter is -0.12)

*** indicates statistically significant at 95% confidence level.

Objective 4: Customer Response and Understanding of the RIB Rate

Between F2013 and F2017, the proportion of customer households that never incurred Step 2 electricity consumption remained generally unchanged at approximately 30 per cent. However, the proportion that sometimes incurred Step 2 consumption (one to 11 months) increased from 39 per cent to 48 per cent while the proportion that always incurred Step 2 consumption (12 months) decreased from 30 per cent to 22 per cent.

Between 2012 and 2017, there was an increase from 53 per cent to 64 per cent in the proportion of customers who believed that BC Hydro's residential electricity prices were too high. In fact, for customers that never incurred electricity consumption beyond Step 1, there was no longer a majority in 2017 – as there was in 2012 – who felt that

prices were ‘about right’. The largest segment of these customers now believed prices were too high.

At 49 per cent in 2012 and 47 per cent in 2017, there has been no meaningful change over the past five years in the proportion of customer respondents who knew that BC Hydro charges their consumption of electricity on an inclining block rate. For these particular customers, they believed that their total bill amounts serve as the greatest incentive to manage their consumption of electricity, followed by electricity prices and then followed by the rate structure. In fact, the RIB rate structure was seen as less of an incentive in 2017 than it was in 2012.

In the 2017 survey, customers previously aware of the RIB rate were more likely than others to have completed a home energy efficiency upgrade in the previous three years, to have participated in at least one of BC Hydro’s conservation programs, and to have outperformed other customers on many in-home conservation behaviours. However, it could not be ascertained through the research if and to what extent awareness of the rate structure led to the decisions to engage in these activities.

Customer support of BC Hydro’s RIB rate decreased from 59 per cent to 55 per cent between 2012 and 2017. Support continues to measure highest among customers who never incur Step 2 electricity consumption in a fiscal year.

5.4 Findings and Recommendations

Findings

Price Elasticity

1. The overall average Step 1 price elasticity was estimated to be -0.14 for F2016 and F2017. Previous analyses, covering the time period of F2005-F2012 and F2005- F2015, were unable to detect Step 1 price elasticity, likely due to relatively low Step 1 prices and small changes in the Step 1 price in earlier years. As a result, Step 1 price elasticity was assumed to be zero in the calculation of energy

savings for F2013 to F2015, which was the same approach used in the 2013 evaluation.

2. Step 2 price elasticity was estimated at -0.08, which is at the low end of the range from the previous evaluation (-0.08 to -0.13). This result may suggest that customer response to the Step 2 price has diminished over time.

3. A range of -0.08 to -0.14 was adopted to estimate natural conservation due to general rate increases under a flat rate in F2016 and F2017. This range spans the empirical estimates for Step 1 and Step 2 price elasticity for F2016 and F2017. In the absence of empirical estimates of flat rate and Step 1 price elasticities in the F2013-F2015 period, the planning assumption of -0.05 was applied for natural conservation in those years.

4. To obtain a proxy estimate of the flat rate elasticity, an analysis of residential consumption data from F2005 to F2016 in New Westminster, a jurisdiction serviced under a flat rate, was conducted. However, it did not produce a statistically significant estimate of flat rate elasticity.

Conservation Impacts of the RIB Rate

1. The annual incremental structural savings from the RIB rate were evaluated at 23 GWh, 3 GWh, and 13 GWh between F2013 and F2015.

2. Given the range of estimated flat rate elasticity due to general rate increases, (-0.08 to -0.14), definitive results for natural conservation and RIB structural savings in F2016 and F2017 could not be determined. Calculated RIB structural savings in F2016 and F2017 decreased as the flat rate elasticity increased. As a result, RIB structural savings in F2016 and F2017 were deemed to be small or zero.

Differences in Price Elasticity by Customer Characteristics

1. Price elasticity by region: Step 1 price elasticity was detected in three out of four geographic regions compared to none in the previous evaluation.[14] Step 2 price elasticity was detected in one region compared to all four regions in the previous evaluation. These results indicate that the Step 2 price is no longer a strong factor in determining electricity consumption in a large part of BC Hydro's service area.
2. Price elasticity by dwelling type: Step 1 price elasticity was identified in four dwelling types compared to none in the previous evaluation. Relative to the previous evaluation, Step 2 price elasticity decreased among single family dwellings and increased among row or townhouses and apartments.
3. Price elasticity by space heating type: Step 1 price elasticity was detected in households with electric and non-electric primary space heating, contrary to the previous evaluation. Step 2 price elasticity was only detected in households with non-electric primary space heating, and at a lower level than in the previous evaluation. The previous evaluation detected Step 2 price elasticity in both types of households. This finding suggests that energy savings induced by price changes from F2013 forward may have come from sources other than electric space heating.
4. Price elasticity in winter vs. summer: The analysis found no statistically significant difference in Step 1 price elasticity between winter and summer and a difference of -0.05 in Step 2 price elasticity—with elasticity being more negative in winter than in summer. This result indicates that for Step 2 consumption, the price sensitivity and price impact are greater in winter than in summer.

Customer Response, Awareness, and Understanding

1. From F2013 through to F2017, the proportion of customer households that incurred at least some Step 2 electricity consumption remained generally even at 70 per cent. Through these five years, however, there was a decrease from

[14] BC Hydro (2014).

30 per cent to 22 per cent in the proportion that were into Step 2 in each month of a fiscal year.

2. Between 2012 and 2017, there was an increase from 53 per cent to 64 per cent in the proportion of customers who felt that BC Hydro's residential electricity prices were too high. Furthermore, the extent that customers felt this way was highly correlated with their exposure to Step 2 electricity consumption.

3. For customers that never incurred electricity consumption beyond Step 1, there was no longer a majority in 2017 – as there was in 2012 – who felt that prices were 'about right'. The largest segment of these customers now believed prices were too high. Their beliefs around the price of electricity in each of the 2012 and 2017 surveys help to explain why a Step 1 price elasticity was not detected until F2016 and F2017 as customers became increasingly responsive to increases in the Step 1 price.

4. Customers' unaided awareness that BC Hydro charges household consumption of electricity on an inclining block rate has gone generally unchanged over the past five years, measuring 49 per cent in 2012 and 47 per cent in 2017.

5. For customers previously aware of the RIB rate in each of the 2012 and 2017 surveys, their total bill amounts emerged as serving more of an incentive to manage their consumption of electricity than did electricity prices or the rate structure. In fact, the inclining block rate was considered to be less of an incentive in 2017 than it was in 2012, which is consistent with the findings regarding price elasticity and conservation.

6. Customers previously aware of the RIB rate in the 2017 survey were more likely than others to have completed a home energy efficiency upgrade in the previous three years, to have participated in at least one of BC Hydro's conservation programs, and to have outperformed them on many in-home conservation behaviours. However, it could not be ascertained through the research if and to

what extent awareness of the rate structure led to the decisions to engage in these activities.

7. The total proportion of customers who support the RIB rate – including those who may have learned about it for the first time in the survey – has decreased from 59 per cent to 55 per cent over the past five years. Support continues to measure highest among customers who never incur Step 2 electricity consumption.

Recommendations

1. Consider whether the existing rate structure continues to serve BC Hydro's business objectives and meet customer needs, given that the current RIB rate structure appeared to yield little or no energy savings in F2016 and F2017.
2. Given the finding that larger consuming customers are more price responsive in the winter than in summer, consider exploring the value of a seasonal rate, with different pricing and consumption thresholds in the winter.
3. Consider the value of targeting small electricity consumers (e.g., those living in apartments) with existing or new DSM program offers, given their increased response to price changes in recent years.

5.5 Conclusions

Although awareness of the RIB rate has remained relatively unchanged over the past five years at just under 50 per cent among all residential customers, the survey analysis has shown that a greater proportion of small customers now feel that electricity prices are too high and the econometric analysis has indicated that they have become more responsive to price changes.

Overall, the RIB rate appears to have achieved its objective of encouraging conservation through the customer response to higher marginal prices. However, the effectiveness of the RIB rate in yielding electricity savings appears to have diminished over time.

6 Residential Retail Program – Consumer Electronics and Appliance Rebate Offers: F2011 to Second Quarter F2015

6.1 Introduction

This report provides the results from an evaluation of the impact of the Residential Retail Program for the period from F2011 through to the second quarter of F2015 (i.e., April 2010 through September 2014). The Residential Retail Program was a multi-year energy acquisition and market transformation initiative that facilitated the use of more energy efficient products by BC Hydro's residential customers. The focus of this evaluation report is on the Consumer Electronics offer and the Appliance Rebate Offer.

Consumer Electronics

The Consumer Electronics offer was launched in 2009 with an objective to reduce the electricity consumption resulting from the increased use of home electronics. When the offer was introduced, it consisted of two main components: new TV sales and old TV recycling. A third component involving set-top boxes was introduced in F2013.

The new TVs component provided a mid-stream incentive to participating retailers for the sale of high efficiency TVs. In-store promotional materials were made available to retailers. Training was offered to sales staff to increase their knowledge of the features and benefits of high efficiency TVs.

Recycling old TVs was promoted through advertising and outreach activities to encourage homeowners to unplug and recycle older used TVs. Outreach activities occurred in F2013 (April and January) and in F2014 (February) in selected communities inviting households to drop off their unwanted TVs at specific locations. A pick-up service was also offered in some communities in F2013 and F2014 in partnership with 1-800 Got Junk.

BC Hydro partnered with TELUS to investigate ways to increase the efficiency of set-top boxes installed by the company among its customer base. BC Hydro provided an

incentive to TELUS to enable the auto-power down feature through a software update across its deployed set-top boxes in F2013, in British Columbia and Alberta. All new boxes purchased after September 2012 were also enabled with the auto-power down feature.

Appliance Rebate Offer

The objective of the appliance rebate offer was to obtain energy savings by encouraging the purchase of the most energy efficient refrigerators, freezers, clothes washers and dishwashers. The program employed a variety of promotional strategies including advertising, point of sale material and improved labelling of products. In addition, training was offered to sales staff to increase their knowledge of the features and benefits of high efficiency appliances. Rebates were provided to purchasers of qualifying refrigerators, freezers, clothes washers, and dishwashers. The appliance rebate offer was introduced in 2008 and operated on a year-round basis until the end of October 2013.

6.2 Approach

Shown below are the evaluation objectives and research questions.

Table 18 Evaluation Objectives and Research Questions

Objectives	Research Questions
1. Program Effectiveness	• How effective were each of the offers at reaching their target markets? • How influential was the program on customers' decisions to purchase high efficiency TVs or appliances, or to recycle their old TVs? • How easy was the process to apply for an appliance rebate? • How did appliance rebate participants rate the dollar value and speed of receiving the rebate? • How did retail partners rate the influence of the program on promoting sales of energy efficient TVs and appliances, and installing energy efficient set-top boxes? • How satisfied were retail partners with the consumer electronics and appliances offers?
2. Market Trends	• What were the sales trends for new TVs? • What were the stocking and price trends among energy efficient TVs and appliances? • What were trends in the types of consumer electronics and appliances installed in BC Hydro residential customer homes?
3. Evaluated net electricity savings – Consumer Electronics	• What were the gross and net electricity savings for new TVs, set-top boxes and recycled TVs? • To what extent could sales of energy efficient TVs, installation of energy efficient set-top boxes and recycling of old TVs be attributed to the Consumer Electronics offer? • To what extent was there spillover associated with the new TVs components of the offer? • How do evaluated net electricity savings compare to reported savings, and what are the reasons for any variance?
4. Evaluated net electricity savings – Appliance Rebate	• What was the rate of free ridership for each type of appliance? • To what extent was there spillover associated with the rebate offer? • What were the gross and net electricity savings for each appliance? • How do evaluated net electricity savings compare to reported savings, and what are the reasons for any variance?

Data sources and methods used to address each of the objectives are summarized in Table 19.

Table 19 Evaluation Objectives, Data Sources and Methods

Objectives	Data sources	Method
1. Program effectiveness	• 2014 Consumer Electronics Survey (n=501) • 2014 Appliance Program Participant Survey (n=1,119) • 2012, 2013, 2014 Retail Partners Surveys (n = 5, 8, 13) • 2015 Cable TV Service Provider interview (n=1)	• Frequency distributions • Cross tabulations • Qualitative analysis
2. Market Trends	• Annual Household Electronics and Appliances Floor Stock Study from 2001 to 2014 (~ 40 stores per year) • Residential End Use Surveys from 2001 to 2014 (n = 4,338 to 7,907 depending on year) • Sales data for new TVs in BC (January 2011 to December 2015)	• Frequency distributions • Cross tabulations • Trend analysis
3. Evaluated net electricity savings – Consumer Electronics	• 2014, 2015 Consumer Electronics Survey (n = 501; 500) • 2012, 2014 Residential End Use Survey (n = 7,907; 7,451) • Sales data for new TVs in BC, from January 2011 to December 2015 • Annual Household Electronics and Appliances Floor Stock Study 2001 to 2014 (~ 40 stores) • 2008 TV and Set-top Box Survey (n=641) • 2010 Residential Monitoring Study (48 homes) • 2015 Consumer Electronics Metering Study (53 homes) • Technology and Market Profile: Consumer Electronics. Marbek (2006) • 2015 Cable TV Service Provider interview (n=1)	• Engineering algorithms • Load shape analysis • Stock and flow model estimates • ARIMA modelling • Common practices baseline using market data analysis • Survey-based program attribution estimation
4. Evaluated net electricity savings – Appliance Rebate	• Program Tracking Data • Annual Household Electronics and Appliances Floor Stock Study 2001 to 2014 (~ 40 stores) • 2014 Appliance Rebate Participant Survey (n=1,119)	• Engineering algorithms • Survey-based participant free rider and spillover estimation

6.3 Results

Objective 1: Program Effectiveness

New Televisions

The program incented between 12 per cent and 30 per cent of all TVs sold annually in B.C. during the evaluation period. It also incented 94 per cent of the high efficiency TVs sold in F2012 and more than half of those sold in F2013 (55 per cent). Aggregating survey results from all years, eight out of 15 retailers indicated that the incentive was very or somewhat influential on their stocking decisions regarding high efficiency TVs. Overall, retail partners were satisfied with BC Hydro's promotions of new TVs.

Of those households that had recently purchased a new TV, 22 per cent recalled seeing promotional materials. Of those who recalled the promotion, 82 per cent purchased a high efficiency model and 94 per cent in that group indicated the promotional materials had influenced their decision to purchase that particular model.

Recycled TVs

Twenty-one per cent of respondents to the 2014 Consumer Electronics Survey reported they recalled seeing, hearing or reading BC Hydro information about recycling TVs. Of those who had recycled a TV after being exposed to the promotional information, 75 per cent reported the campaign influenced their decision to recycle.

Set-top Boxes

TELUS rated BC Hydro's encouragement and financial support as very important to enabling the auto-power down feature of their set-top boxes and the incentive provided the financial support needed to activate the auto-power down feature. As explained in the interview, TELUS had not considered energy efficiency prior to being approached by BC Hydro.

Appliances

Results of the Appliance Program Participant Survey show that 51 per cent of respondents first learned of the appliance rebate from a salesperson on the floor of the retail store, and 26 per cent learned of the rebate through in-store stickers and labels. Overall, 88 per cent of respondents reported that their experience with the program was good or excellent, including the ease of applying for the rebate. While still favourable, ratings of the speed of receiving the rebate cheque were slightly lower, with 75 per cent giving ratings of good or excellent. The total dollar amount of the rebate was rated lower with 63 per cent of participants assessing the rebate amount favourably. Reported influence of the customer appliance rebate on retailers was mixed.

Objective 2: Market Trends

Televisions

TVs were, and continue to be, a rapidly changing technology. The type of TV installed in BC Hydro customers' homes has changed substantially over the past ten years, in particular the move away from the standard CRT TV to LCD and LED-LCD TVs. The proportion of households with a CRT TV plummeted to 29 per cent in 2014 from 98 per cent in 2001. This decline was accompanied by a rapid increase in LCD models, rising from 8 per cent of households in 2006 to 76 per cent in 2014.

In terms of total TV sales in BC, there has been a declining trend from the beginning of 2011 to the latter part of 2015, and the sale of non-Energy Star televisions has been in general decline since F2012. The price of TVs with higher energy efficiency ratings tended to be slightly higher than the average of all Energy Star models.

Appliances

In 2014, almost all households (96 per cent) had at least one refrigerator, the majority of which were auto-defrost. Fifty per cent of households in the BC Hydro service territory had at least one freezer in 2014, down from 63 per cent in 2001.

In 2010, 2012 and 2014, approximately 90 per cent of households in BC had a clothes washer. The type of clothes washers installed by residential customers also changed over the evaluation period with 53 per cent of households in 2014 reported having a top-load clothes washer, down from 90 per cent in 2001. For the past ten years, slightly more than three-quarters of households in the BC Hydro service area had a dishwasher.

The average proportion of Energy-Star rated appliances on display in BC retail stores from 2009 to 2014 was 76 per cent for refrigerators, 78 per cent for clothes washers and 84 per cent for dishwashers. Energy Star freezers represented an average of 43 per cent of displayed models.

Objective 3: Evaluated net electricity savings – Consumer Electronics

New Televisions

Evaluated net savings were calculated by multiplying the total number of incented televisions by the average unit savings in each fiscal year and adjusted for cross effects. A separate analysis did not detect any lasting trends in the sales of high efficiency TVs and there was no spillover associated with the new TV sales component of the program. Note that the common practice baseline approach accounts for any free ridership that might be present. Table 20 summarizes the inputs and results for evaluated net savings as well as the reported net savings for high efficiency television sales.

Table 20 Evaluated and Reported Net Savings for New TVs

Fiscal Year	Total Units Incented	Avg. Unit Savings (kWh/year)	Cross Effect Adjustment (1-0.03)	Evaluated Net Savings (GWh/year)	Reported Net Savings (GWh/year)
F2011	58,998	34	0.97	1.9	3.2
F2012	120,360	16	0.97	1.9	6.3
F2013	74,620	31	0.97	2.2	2.8
F2014	26,098	36	0.97	0.9	1.1
Total*	**280,076**	**--**	**--**	**7.0**	**13.3**

*Columns may not sum to total due to rounding.

Evaluated net savings for the evaluation period were 7.0 GWh per year, or roughly half of the reported net savings of 13.3 GWh per year. The greatest variance between reported and evaluated savings occurred in F2012 when incented TVs accounted for 94 per cent of high efficiency TV sales in BC and when unit savings were the smallest. It is not conclusive whether the convergence of rebated and total market sales suggests high free ridership in that year or is indicative of the influence previous program efforts had on retailers to stock more of the high efficiency TVs.

Set-top Boxes

The net to gross ratio for set-top boxes was evaluated as 100 per cent, based on the results of the service provider interview. Evaluated and reported net savings for set-top boxes are presented in Table 21.

Table 21 Set Top Box Evaluated and Reported Net Savings

Fiscal Year	Evaluated Gross Savings (GWh/year)	Net to Gross Ratio	Evaluated Net Savings (GWh/year)	Reported Net Savings (GWh/year)
F2013	4.1	1	4.1	5.1
F2014	0.6	1	0.6	0.7
F2015 (Q1-Q2)	0.3	1	0.3	0.4
Total	**5.0**	--	**5.0**	**6.2**

As shown in the above table, evaluated net savings for the evaluation period were slightly lower than reported. The variance between evaluated and reported net savings is due to reported savings assuming higher unit savings and more time spent in active mode relative to evaluated results.

Recycled TVs

Program tracking data was not available for recycled TVs because this component only consisted of promotional activities. Evaluated gross savings were based on information garnered from several sources and were adjusted for a cross effect factor of 3 per cent. The gross savings were further adjusted by an attribution score to account for program influence on recycling. The attribution score was based on self-report by those who had recycled a TV and calculated to be 5 per cent. Evaluated net savings were 6.5 GWh for the evaluation period, which was almost the same as reported net savings, as summarized in Table 22.

Table 22 Evaluated and Reported Gross and Net Savings for Recycled Televisions

Fiscal Year	Evaluated Gross Savings (GWh/year)	Cross Effect Adjustment (1 - .03)	Attribution Score	Evaluated Net Savings (GWh/year)	Reported Net Savings (GWh/year)
F2011	22.4	0.97	0.05	1.1	1.1
F2012	22.4	0.97	0.05	1.1	1.9
F2013	42.9	0.97	0.05	2.1	2.0
F2014	42.9	0.97	0.05	2.1	1.6
Total	**130.6**	**--**	**--**	**6.5***	**6.6**

* Columns may not sum to total due to rounding.

Summary of Net Savings Results for Consumer Electronics

The evaluated and reported net savings for each component of the consumer electronics offer are summarized in Table 23. The share of total evaluated savings was fairly evenly split across the three components of the offer.

Table 23 Reported and Evaluated Net Savings for the Consumer Electronics Offer: F2011 - F2015, Q1-Q2 (GWh/year)

	New TVs		Recycled TVs		Set-top Boxes		Total	
Fiscal Year	Reported	Evaluated	Reported	Evaluated	Reported	Evaluated	Reported	Evaluated
F2011	3.2	1.9	1.1	1.1	--	--	4.3	3.0
F2012	6.3	1.9	1.9	1.1	--	--	8.2	3.0
F2013	2.8	2.2	2.0	2.1	5.1	4.1	9.9	8.4
F2014	1.1	0.9	1.6	2.1	0.7	0.6	3.4	3.6
F2015 (Q1-Q2)	--	--	--	--	0.4	0.3	0.4	0.3
TOTAL*	**13.3**	**7.0**	**6.6**	**6.5**	**6.2**	**5.0**	**26.2**	**18.3**

* Columns may not sum to total due to rounding.

Objective 4: Evaluated electricity savings – Appliance Rebate

Due to data limitations, an estimate of net savings attributable to the program, inclusive of the program's effect on retailers, could not be developed. Therefore, evaluated net savings have not been calculated for the appliance rebate component of the program, as program attribution could not be fully estimated.

Evaluated gross savings were calculated by multiplying average unit savings by the number of units rebated and adjusting for cross effects, where applicable. The cross

effect factor applied to evaluated savings was 1.7 per cent for refrigerators and 0.5 per cent for freezers. Cross effect values used in the reported savings varied from 9.7 per cent to 1.8 per cent for refrigerators and 2.7 per cent to 0.3 per cent for freezers.

As shown in Table 24, evaluated gross savings were 19.3 GWh per year. Clothes washers achieved the largest savings, accounting for 79 per cent of the total gross savings. Evaluated gross savings were higher than reported gross savings, which were 10.2 GWh per year. The variance between evaluated and reported gross savings is largely due to the inclusion of additional energy savings from clothes drying associated with high efficiency clothes washers.

Table 24 Evaluated and Reported Gross Savings: F2011 -F2015, Q1-Q2 (GWh/year)

Fiscal Year	Refrigerators	Freezers	Dishwashers	Clothes Washers	Total Evaluated Gross Savings	Total Reported Gross Savings
F2011	0.8	0.5	0.1	4.5	**5.9**	**3.9**
F2012	0.5	0.4	0.2	4.9	**6.0**	**2.3**
F2013	0.7	0.2	0.2	3.7	**4.8**	**2.5**
F2014	0.4	0.2	<0.1	1.8	**2.4**	**1.3**
F2015 (Q1-Q2)	<0.1	--	--	0.3	**0.3**	**0.2**
Grand Total*	**2.4**	**1.3**	**0.4**	**15.2**	**19.3**	**10.2**

*Columns may not sum to total due to rounding.

The evaluation found free ridership, from the perspective of customers who received a rebate, to be in the range of 71 per cent to 76 per cent for all appliances across all fiscal years in the evaluation period. The free rider analysis captured the purchasers' perspectives of program influence on their purchase decisions and focused mainly on the rebate. Participant spillover was estimated to be negligible on an annual basis (less than 1 per cent per year) and totaled 0.1 GWh per year over the evaluation period. Data collected from non-participants were insufficient to reliably estimate non-participant spillover.

The appliances rebate offer was designed to influence both retailers and consumers. Retailer engagement, education and training activities were intended to influence retail

partners to increase the stocking of high efficiency products and to improve the positioning and promotion of these products. BC Hydro's advertising and promotional activities also aimed to improve customers' awareness of high efficiency options and, in conjunction with the rebate, influence their decision to purchase high efficiency appliances. Data collected through the retailer surveys was intended to measure the indirect attribution of energy efficient appliance sales to the program via its influence on retailer stocking, pricing and selling practices. Due to data limitations, an estimate of the program's effect on retailers could not be developed.

Summary of Savings Results for the Residential Retail Program

Presented in Table 25 are the annual incremental and peak demand savings associated with the consumer electronics program component.

Table 25 Summary of Reported and Evaluated Net Energy and Peak Demand Savings for Consumer Electronics

	Net Energy Savings (GWh/year)		Net Peak Demand Savings (MW)	
Fiscal Year	Reported	Evaluated	Reported	Evaluated
F2011	4.3	3.0	1.1	0.7
F2012	8.2	3.0	2.0	0.7
F2013	9.7	8.4	2.4	2.0
F2014	4.0	3.6	1.0	0.9
F2015 (Q1-Q2)	0.6	0.3	0.1	0.1
TOTAL	**26.8**	**18.3**	**6.5**	**4.4**

*Columns may not sum to total due to rounding.

Gross peak demand savings were estimated by multiplying evaluated gross energy savings by the ratio of BC Hydro's system peak demand, in MW, to annual energy consumption, in GWh, derived from residential end-use load shapes. The reported and evaluated peak demand savings for each offer are presented in Table 26.

Table 26 Summary of Reported and Evaluated Gross Energy and Peak Demand Savings for Appliances

	Gross Energy Savings (GWh/year)		Gross Peak Demand Savings (MW)	
Fiscal Year	Reported	Evaluated	Reported	Evaluated
F2011	3.9	5.9	0.7	1.0
F2012	2.3	6.0	0.4	1.0
F2013	2.5	4.8	0.5	0.8
F2014	1.3	2.4	0.2	0.4
F2015 (Q1-Q2)	0.2	0.3	0.0	0.1
TOTAL*	**10.2**	**19.3**	**1.8**	**4.0**

*Columns may not sum to total due to rounding.

6.4 Findings and Recommendations

Findings

Program Effectiveness

1. There was evidence to suggest the program had some influence on retailers' decisions regarding stocking and display of high efficiency TVs. However, the evidence was too weak to ascribe any program effects on retailer behaviours and subsequent influences on consumer decision-making and purchases.

2. Partnerships with BC Hydro to deliver the program were successful. Retail partners reported high levels of satisfaction with the new TV and appliance rebate components of the program. The partnership with TELUS was particularly successful as BC Hydro played the key role in identifying a way for TELUS to improve the energy efficiency of set-top boxes installed in their customers' homes.

3. Survey results for the appliance rebate offer indicate that retailer activities and BC Hydro promotional activities reached the target market of residential customers thinking of purchasing a new appliance. In contrast, survey results suggest that the promotional activities of the consumer electronics offer were more limited in reach. However, the influence of the messaging among those who recalled seeing it was high for all three components.

4. Participants in the appliance rebate offer had a positive experience, rating the qualification and application processes as easy to navigate. They were somewhat less satisfied with the amount of time it took to receive the rebate and the rebate amount, but responses were positive overall.

Market Trends

1. There has been a substantial change in the types of TVs installed in BC Hydro customers' homes over the past ten years, with CRT models steadily becoming less prominent. Overall, TV sales declined over the evaluation period.
2. Characteristics of clothes washers and refrigerators have been changing since 2001. The share of households with front-load and top-load clothes washers has converged towards 50 per cent each in 2014. Overall, the percentage of households that have at least one freezer has declined, with chest freezers becoming less popular.
3. In terms of retailer showroom presence, the shares of energy efficient appliances (i.e., Energy Star) fluctuated due to changes in the Energy Star ratings. However, a high majority of refrigerators, clothes washers and dishwashers were Energy Star, as were a smaller share of freezers. No clear price trends for energy efficient appliances were identified.

Evaluated Net Electricity Savings – Consumer Electronics

1. Overall, evaluated net savings for the consumer electronics offer were 31 per cent lower than reported for the evaluation period (18.3 GWh per year as compared to 26.8 GWh per year). The largest difference between reported and evaluated savings occurred in new TVs and can be ascribed to the convergence of the energy efficiency of program qualifying TVs and the overall TV market. The rapidly changing television market made it challenging for the program to stay ahead of the market in terms of new technologies and higher levels of energy efficiency. The effect of program activities on TV retail partner stocking, positioning and sales efforts was not fully captured from the data sources available to this evaluation.

2. Using information from several different sources, the evaluation estimated a total 812,831 TVs were recycled over the period from F2011 to F2014. Approximately 5 per cent of gross savings from these recycled TVs could be attributed to program activities, as would be expected given that the initiative was limited to advertising and outreach activities.

Evaluated Electricity Savings – Appliances

1. Evaluated gross savings were close to double that of reported savings for the appliances rebate offer (19.3 GWh as compared to 10.2 GWh). Overall, clothes washers accounted for 59 per cent of appliance rebates and 79 per cent of the evaluated gross energy savings over the evaluation period. Refrigerators accounted for 20 per cent of the rebated appliances and 12 per cent of the offer's overall gross savings.
2. The variance between evaluated and reported gross savings was due mainly to differences in the unit energy savings calculated for clothes washers. Evaluated unit savings for clothes washers were higher than reported as a result of including additional savings in clothes drying associated with high efficiency clothes washers.
3. Evaluated free ridership, from the perspective of customers who received an appliance rebate, was higher than that assumed in reported savings (71 to 76 per cent as compared to 11 to 20 per cent, respectively) and evaluated participant spillover was lower than that assumed in reported (1 per cent as compared to 10 to 25 per cent, respectively).
4. It is reasonable to believe that the program induced incremental sales of high efficiency appliances by influencing retailer product stocking and sales practices (i.e., market effects) and by influencing consumers who saw the program's advertising or were aware of the rebate but did not apply for one (i.e., non-participant spillover). However, any savings through these streams were not

captured in this evaluation as the data available did not permit the development of a valid attribution score or an estimate of non-participant spillover.

5. Evaluated net savings for appliances are not reported for this evaluation due to the incomplete information about program influence on non-participants and retailers, and the indirect influence on appliance purchasers. The rationale for this decision is that it would be inappropriate to apply the free rider scores without understanding and accounting for other influences, beyond the rebate, on purchaser decision-making.

Recommendations

Recommendations 1 to 4 are for program management. Recommendation 5 is for Evaluation and Recommendations 6 and 7 are for both. The recommendations are not presented in any order of priority.

1. Explore why the speed of receiving their appliance rebates is considered less than satisfactory by a portion of applicants and how the issuance of rebates could be accelerated to improve customer ratings.
2. Continue to collect comprehensive sales data from retail partners for tracking and evaluating market trends and assessing program impacts of retail programs.
3. If clothes washers continue to be included in the appliance rebate offer, update the calculation of reported clothes washer savings to incorporate savings in clothes drying.
4. Consider options to modify the program offers or target markets to reduce free ridership.
5. For offers featuring an incentive paid to retailers, examine program influence on retailers in greater depth to better understand and account for market effects and associated energy savings.

6. Evaluation and Marketing should consider collecting additional data to enable the evaluation of non-participant spillover and market effects from the appliance offer in the future.
7. Consider the feasibility of evaluating advertising-only initiatives (like TV recycling) and how to collect the necessary data for any subsequent evaluation.

6.5 Conclusions

Evaluated savings for the Consumer Electronics offer were lower than reported, mainly due to the convergence of the energy consumption of program qualifying televisions and the television market overall. The set-top box component of the program was successful in transforming the products of a major service provider partner.

Evaluated gross savings for the appliances rebate were almost double the reported savings as a result of including savings from clothes drying. The evaluation did not estimate net savings for the Appliances Rebate offer as the effects of the program on retail partner behaviours or additional savings due to non-participant spillover and market effects were not adequately captured.

Glossary

ANCOVA: is a general linear model which blends ANOVA and regression to test the main and interaction effects of categorical variables on a continuous dependent variable, controlling for the effects of selected other continuous variables, which co-vary with the dependent.

Baseline: A baseline is the initial condition occurring when a DSM activity begins. It may be a market share for equipment, a current standard, or a current average behavior.

BC Hydro Service Area: The portion of the Province of B.C. that receives retail electricity service from BC Hydro. The service area excludes the portion of the Province of B.C. served by Aquila Networks Canada (previously known as West Kootenay Power and Utilicorp Networks Canada), FortisBC, and certain factories or communities that are not customers of BC Hydro. Approximately 75 per cent to 80 per cent of B.C.'s demand for electricity is in the BC Hydro service area and is supplied by BC Hydro.

Cross Effects: Cross effects (also known as interactive effects) refer to the effect that some energy conservation measures (**ECMs**) have on other electricity end uses beyond what the ECM itself produces. An obvious example is building lighting. As more efficient lighting is installed, less heat is generated by the lighting system. This means that less heat must be removed from the building by the air conditioning system during the cooling season, but more heat needs to be supplied by the heating system during the heating season.

Demand Side Management (DSM): The definition of Demand Side Management is the same as the definition of "demand-side measures" set out in section 1 of the *Clean Energy Act*, which is "a rate, measure, action or program undertaken; (a) to conserve energy or promote energy efficiency, (b) to reduce the energy demand a public utility must serve, or (c) to shift the use of energy to periods of lower demand, but does not include (d) a rate, measure, action or program the main purpose of which is to

encourage a switch from the use of one kind of energy to another such that the switch would increase greenhouse gas emissions in British Columbia, or (e) any rate, measure, action or program prescribed".

End Use: The final application or final use to which energy is applied. Recognition of the fact that electric energy is of no value to a user without first being transformed by a piece of equipment into a service of economic value. For example, office lighting is an end use, whereas electricity sold to the office tenant is of no value without the equipment (light fixtures, wiring, etc.) needed to convert the electricity into visible light. End use is often used interchangeably with energy service.

ENERGY STAR®: ENERGY STAR® is the mark of high-efficiency products in Canada that meet strict technical specifications for energy performance—tested and certified. These products save energy without compromising performance in any way. Typically, an ENERGY STAR® certified product is in the top 15 to 30 per cent of its class for energy performance.

Expected Savings: Estimate of gross energy savings based on customer initially reported savings, engineering review and site inspection. These estimates represent the unverified savings.

Free Riders: Free riders are program participants who would have taken the DSM action, even in the absence of the DSM program. They are a part of the reference case. These actions are not attributable to the program.

Gigawatt Hour (GWh): One billion watt-hours; one million kilowatt hours.

Gross Savings : The change in energy consumption and/or associated demand that results directly from program-related action taken by the participants in the demand side management program irrespective of why they participated.

Market Transformation: Market Transformation refers to a permanent change in the structure or functioning of markets, including more energy-efficient behaviour among customers and higher market penetration of energy-efficient products, as a result of

DSM programs that reduce barriers to energy efficiency. These market changes are likely to persist in the absence of continued program activity.

Mid-stream/upstream: The term mid-stream is used in reference to the part of the supply chain that is closer to the customer, such as retailers or contractors. The term up-stream can be used in two ways: 1) to refer to the manufacturers of products or, 2) more generically, to indicate suppliers to the purchasers.

Net savings: The change in energy consumption and/or associated demand that is attributable to the utility DSM program. The change in consumption or associated demand may include the effects of free riders and spillover.

Net-to-gross ratio: A factor representing net demand side management program savings divided by gross program savings that is applied to gross program impacts to convert them into net program load impacts. The factor is made-up of a variety of factors that create differences between gross and net savings, commonly including free riders and spillover. Other adjustments may include rebound, cross effects and measurement and verification results.

Non-energy benefits: Benefits that accrue to program participants (e.g., increased property values, decreased water and sewer bills, increased comfort, health and safety), to the utility (e.g., bill payment improvements, decreased service calls), or to society in general (e.g., improved environmental health, job creation).

Peak Demand - Demand refers to the amount of electricity that is consumed at any instant in time, measured in multiples of watts. Peak demand savings are the reduction in amount of electricity that is consumed at system peak demand, which for BC Hydro occurs on a winter weekday between approximately 5 p.m. and 7 p.m.

Persistence: Refers to how long the energy savings are expected to be attributable to the demand side management activity.

Precision: The degree to which repeated measurements under unchanged conditions show the same results.

Quasi-Experimental Design: is an empirical study used to estimate the causal impact of an intervention on its target population. Quasi-experimental research shares similarities with the traditional experimental design or randomized controlled trial, but they specifically lack the element of random assignment to treatment or control. Instead, quasi-experimental designs typically allow the researcher to control the assignment to the treatment condition, but using some criterion other than random assignment. A well designed Quasi-Experiment can control on key factors when a randomized controlled trial is not practical.

Realization Rate: The ratio of initial estimates of savings to savings adjusted for data errors and measurement and verification results. Does not reflect program attribution or influence on the savings achieved.

Reported Savings: Estimate of energy savings being recorded in the program tracking database. Reported savings are based on best information available from technical review of the initial engineering estimate, post implementation review of documentation and/or inspection, or measurement and verification results, as well as, a forecast net-to-gross ratio applied.

Spillover: Refers to program participants and non-participants whose energy savings measures occur through actions that are not part of a program, but which were influenced by the program (also called free drivers or tag-ons). Participant spillover is the additional energy savings that occur when a program participant independently installs energy efficiency measures or applies energy savings practices after having participated in the efficiency program, as a result of the program's influence. Non-participant spillover refers to energy savings that occur when a program non-participant installs energy efficiency measures or applies energy savings practices as a result of a program's influence. Spillover is expressed as a fraction of the increase of energy savings due to spillover to the gross energy savings of the program participant. Spillover may not be permanent and may not continue in the absence of continued program activity.

Evaluation of the Residential Inclining Block Rate

F2013-F2017

April 2018

Prepared by: Conservation and Energy Management Evaluation

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Executive Summary

Introduction

The Residential Inclining Block (RIB) rate is a two-step rate structure where BC Hydro's residential customers pay a lower price for electricity consumption up to a certain threshold, and a higher price for electricity consumption beyond the threshold.

The RIB rate went into effect in October 2008 for approximately 1.6 million residential customers. The Step 1 to Step 2 threshold was set at 1,350 kWh per two-month billing period, which was approximately 90 percent of the median consumption of BC Hydro's residential customers. The Step 2 rate was established at BC Hydro's current estimate of the cost of new energy supply, grossed up for losses, and the Step 1 rate was calculated to achieve revenue neutrality for the residential class. The over-arching objective of the RIB rate was to use price to encourage additional electricity conservation relative to what was achievable through a flat rate structure.

The last evaluation of the RIB rate was conducted in 2013[1] and evaluated the price elasticity of consumption and the electricity conservation impacts in response to the rate's two-step structure, as well as customer awareness, understanding, and response to the RIB rate for the period from October 2008 through March 2012 (the mid-point of F2009 through F2012). This evaluation is a continuation of the 2013 evaluation, and covers April 2012 through March 2017 (F2013-F2017).

Approach

The evaluation objectives and research questions are shown on the following page.

[1] BC Hydro (2014) "Evaluation of the Residential Inclining Block Rate F2009-F2012", Revision 2, Power Smart Evaluation, BC Hydro.

Table E.1: Evaluation Objectives and Research Questions

Objectives	Research Questions
1. Estimate Price Elasticity	• What is the price elasticity of Step 1 and Step 2 consumption? • Is there a difference in price elasticity between BCH customers and a comparable community without a RIB rate (e.g. New Westminster)? • What is the price elasticity due to natural conservation, as measured by the price response to general rate increases through F2017? • How do the results of research questions related to price elasticity compare to previous research on this topic conducted as part of the last RIB rate evaluation?
2. Estimate the Conservation Impacts of the RIB Rate	• What are the energy savings due to BC Hydro's RIB Rate from F2013 to F2017? • What are the peak demand savings due to BC Hydro's RIB rate from F2013 to F2017? • What are the energy savings due to natural conservation from F2013 to F2017, as measured by the price response to general rate increases?
3. Analyze Differences in Price Elasticity by Customer Characteristics	• Are there differences in price elasticity by region? • Are there differences in price elasticity by dwelling type? • Are there differences in price elasticity by space heating type? • How do the results of research questions related to price elasticity compare to previous research on this topic conducted as part of the last RIB rate evaluation? • Are there differences in price elasticity between winter and summer periods?
4. Evaluate the Customer Response and Understanding of the RIB Rate	• Are there differences in the characteristics or demographics of customers who are never billed in Step 2 compared to those who are sometimes or always billed in Step 2? • What is the level of customer awareness and understanding of the RIB rate? • To what degree do customers believe electricity prices provide an incentive to manage electricity consumption? • To what extent do customers believe the total electricity bill amount provides an incentive to manage electricity consumption? • What is customers' understanding of their prevailing electricity price under the RIB rate structure? • To what extent do customers believe the RIB provides an incentive to manage electricity consumption? • To what extent do RIB aware customers report energy conserving behaviours as compared to non-RIB aware customers? • To what extent do RIB aware customers report implementing longer term capital investment in energy efficiency or conservation as compared to non-RIB aware customers? • Was program participation in DSM programs different between customers aware / not aware of the RIB rate? • Did low income customers have a different perception or response to the RIB Rate? • Does the RIB rate have any impact on customers' decisions on fuel switching from electricity to thermal fuels? • Is the RIB rate perceived as a barrier to electrification? • Has customers' response/acceptance to RIB changed over time? • Do customers support the RIB rate? • Do notifications / alerts on Step 2 have an impact on customers' consumption behaviour? • How do the results of research questions related to customer response and understanding of the RIB rate compare to previous research on this topic completed as part of the last RIB rate evaluation or REUS surveys?

The table below summarizes the data sources and methods employed in this study for each evaluation objective.

Table E.2: Summary of Evaluation Objectives, Data Sources and Methods

Evaluation Objective	Data Sources	Methods
1. Estimate Price Elasticity	• BC Hydro billing data from April 2004 to December 2016, including electricity consumption, space heating fuel, region and dwelling type by account • BC Hydro residential rate prices from April 2004 to December 2016 • BC Hydro DSM expenditures and savings, from 2004 to 2017 • BC Consumer Price Index data from April 2004 to December 2016 obtained from Statistics Canada • BC real disposable income from April 2004 to December 2016 from BC Stats • Heating and cooling degree days by region from April 2004 to December 2016 • New Westminster customer billing data from 2005 to 2016 and customer information on heating fuel and dwelling type	• Econometric modelling of price elasticity
2. Estimate the Conservation Impacts of the RIB Rate	• Data and results from Objective 1 • BC Hydro residential rate class load shape	• Calculation based on price elasticity and rate class load shape
3. Analyze Differences in Price Elasticity by Customer Characteristics	• Same as Objective 1	• Same as Objective 1
4. Evaluate the Customer Response and Understanding of the RIB Rate	• 2012 customer survey (n = 2,468) • 2017 customer survey (n = 3,307) • 2014 Residential End-Use Study (n=7,318) • 2017 Residential End-Use Study (n=6,929) • BC Hydro billing data from F2012 and F2017 • Data on customer sign-ups for Step 2 alerts • BC Hydro residential DSM program tracking data	• Cross tabulations of survey responses • Linking of survey responses to respondent billing history • Difference in proportions z-tests • Difference of Means Tests using Analysis of Variance

Objective 1, estimating price elasticity, and Objective 3, analyzing elasticities differences by customer characteristics, were addressed through econometric modeling which utilized a variety of data sources including electricity consumption and Statistics Canada data. Objective 2 was a calculation using the results from Objective 1.

Objective 4, related to evaluating customer response and understanding of the RIB rate, was largely addressed through analysis and comparison of the results from two similar residential customer surveys which were delivered in 2012 and 2017.

Results

Price Elasticity

Step 1 consumption represents the consumption of those customers whose bi-monthly usage does not exceed the 1,350 kWh threshold. The Step 1 price elasticity of these customers was estimated to be -0.14. The previous RIB evaluation in 2013 was unable to detect a Step 1 price elasticity over the F2009 to F2012 period, nor did a subsequent analysis over the F2009 to F2015 period. Due to the fact that Step 1 price elasticity could not be detected for the F2009 to F2015 period, the estimate of -0.14 was only seen to be applicable to F2016 and F2017.

Step 2 consumption represents the consumption of those customers whose bi-monthly usage exceeds the 1,350 kWh threshold. The Step 2 price elasticity of these customers was estimated to be -0.08, which is at the low end of the range estimate of -0.08 to -0.13 from the 2013 evaluation. The current estimate indicates that in comparison to the earlier years of the RIB rate, customers who were exposed to Step 2 prices in recent years may have become less price responsive—measured by percentage change in consumption—to Step 2 price increases. It also indicates that their capacity and options to conserve energy while facing price increases may have been more limited in recent years. Meanwhile, Step 1 consumption has become price sensitive in recent years.

Table E.3: Step 1 and Step 2 Price Elasticity Estimates

Time Series Analyzed	Step 1 Elasticity	Step 2 Elasticity
F2005-F2012	Not statistically significant	-0.08 to -0.13***[2]
F2005-F2015[3]	Not statistically significant	Not analyzed
F2005-F2017	-0.14***	-0.08***

*** indicates statistically significant at 95% confidence level

The price elasticity of electricity consumption under a flat rate is used to calculate the natural conservation impact that would be achieved by general rate increases as per BC Hydro's approved Revenue Requirements. This flat rate price elasticity is used to estimate the baseline conservation that would have occurred in the absence of the RIB rate. The flat rate price elasticity could not be estimated through econometric analysis. A range estimate between the Step 1 and Step 2 elasticities was adopted (-0.08 to -0.14) to calculate the natural conservation impact. Since the Step 1 price elasticity estimate of -0.14 was only applicable to F2016 and F2017, the range estimate of the flat rate elasticity was similarly applied to F2016 and F2017 only. In the absence of an empirical estimate of flat rate elasticity in the F2013 to F2015 period, the planning assumption of -0.05[4] was applied to those years.

Conservation Impacts of the RIB Rate

In order to evaluate additional energy conservation achieved under the RIB rate relative to the flat rate, the energy impacts of the Step 1, Step 2, and the flat rate price response were calculated separately. The baseline scenario was considered natural conservation achieved under the flat rate due to general rate increases and the RIB rate structural savings were calculated as the sum of the Step 1 and Step 2 energy impact, less the natural conservation impact. The annual incremental structural savings from the RIB rate between F2013 and F2015 are presented below. The calculations are based on the value of Step 1 elasticity (zero), Step 2 elasticity (-0.08) and assumed flat rate elasticity (-0.05).

[2] BC Hydro (2014)

[3] In 2016, an analysis was conducted to evaluate the Step 1 price elasticity for the period of F2005-F2015. This analysis did not produce statistically significant results. The modelling outputs from this analysis were included in Appendix D.

[4] Orans, R (2008), the source and reasons for adopting this assumption were provided in the expert testimony of the 2008 BC Hydro Long-Term Acquisition Plan, Appendix E.

Table E.4: RIB Rate Savings F2013-F2015

Fiscal Year	Step 1 Price Impact (GWh)	Step 2 Price Impact (GWh)	Natural Conservation (GWh)	RIB Structural Savings (GWh)
	A	B	C	(A + B - C)
Elasticity	**0.00**	**-0.08**	**-0.05**	**-**
F2013	-	49	24	23
F2014	-	16	13	3
F2015	-	74	62	13

Given the potential range in flat rate elasticity (-0.08 to -0.14; assuming that it lies between the estimates of Step 1 and Step 2 elasticity), natural conservation and RIB structural savings in F2016 and F2017 could not be estimated with precision. Table E.5 shows the calculation of natural conservation and RIB structural savings using four different flat rate elasticities: -0.08, -0.09, -0.10 and -0.14. Based on this calculation, savings appear to decrease as flat rate elasticity increases. Based on the results derived through the range estimate, the evaluated RIB energy savings in F2016 and F2017 were deemed to be small or zero, as shown in table E.6 below.

Table E.5: RIB Rate Savings F2016-F2017

	Step 1 Price Impact (GWh)	Step 2 Price Impact (GWh)	Natural Conservation (GWh)				RIB Structural Savings (GWh)			
	A	B	C				(A + B- C)			
Elasticity	**-0.14**	**-0.08**	**-0.08**	**-0.09**	**-0.10**	**-0.14**	**-0.08**	**-0.09**	**-0.10**	**-0.14**
F2016	26	45	60	67	75	104	11	4	(3)	(33)
F2017	13	23	29	33	37	52	6	2	(2)	(16)

Based on the estimates of Step 1 (-0.14), Step 2 (-0.08), and the adopted flat rate elasticity range (-0.08 to -0.014) , the energy and peak demand saving impacts attributed to the RIB rate were calculated as presented in the table below.

Table E.6: Reported and Evaluated RIB Rate Savings

	Energy Savings (GWh)		Peak Demand Savings (MW)	
Fiscal Year	**Reported**	**Evaluated**	**Reported**	**Evaluated**
F2013	42	23	9	5
F2014	19	3	4	1
F2015	59	13	12	3
F2016	29	0 to 11	6	0 to 2
F2017	8	0 to 6	2	0 to 1

Two major factors contribute to the variance between reported and evaluated RIB rate savings. First, the Step 2 price elasticity of -0.08 was smaller (in absolute value) than the planning assumption of -0.1. Second, the flat rate elasticity range estimate applied to F2016 and F2017 was higher (in absolute value) than the value used in the forecast of RIB savings (-0.05).

Price Elasticity by Customer Characteristics

Additional analyses were conducted to determine if separate price elasticity estimates could be identified based on season or specific customer characteristics such as region, dwelling type, and space heating fuel. Those results are presented in Table E.7, where each category (region, dwelling type, space heating, winter vs summer) shows the results of a separate regression analysis. The results included in Table E.7 show that Step 1

and Step 2 price elasticity varied by region, dwelling type, space heating type and winter versus summer. In some instances, the elasticity estimate was not statistically significant.

Table E.7: Step 1 and Step 2 Price Elasticity by Customer Characteristics

Customer Segment	Step 1 Elasticity	Step 2 Elasticity
Region		
Lower Mainland	-0.22***	Not statistically significant
Vancouver Island	-0.18***	-0.12***
Southern Interior	Not statistically significant	Not statistically significant
North	-0.23***	Not statistically significant
Dwelling Type		
Single Family Dwelling	-0.04***	-0.08***
Row/Townhouse	-0.14***	-0.10***
Apartment	-0.26***	-0.07***
Mobile Home	-0.12***	-0.09***
Space Heating		
Electric	-0.11***	Not statistically significant
Non-Electric	-0.18***	-0.17***
Winter vs. Summer	Not statistically significant	More negative by 0.05 in winter than in summer (e.g. if summer price elasticity is -0.07, winter is -0.12)

*** indicates statistically significant at 95% confidence level

Customer Response and Understanding of the RIB Rate

Between F2013 and F2017, the proportion of customer households that never incurred Step 2 electricity consumption remained generally unchanged at approximately 30 percent. However, the proportion that sometimes incurred Step 2 consumption (1-11 months) increased from 39 percent to 48 percent while the proportion that always incurred Step 2 consumption (12 months) decreased from 30 percent to 22 percent.

Between 2012 and 2017, there was an increase from 53 percent to 64 percent in the proportion of customers who believed that BC Hydro's residential electricity prices were too high. In fact, for customers that never incurred electricity consumption beyond Step 1, there was no longer a majority in 2017 – as there was in 2012 – who felt that prices were 'about right'. The largest segment of these customers now believed prices were too high.

At 49 percent in 2012 and 47 percent in 2017, there has been no meaningful change over the past five years in the proportion of customer respondents who knew that BC Hydro charges their consumption of electricity on an inclining block rate. For these particular customers, they believed that their total bill amounts serve as the greatest incentive to manage their consumption of electricity, followed by electricity prices and then followed by the rate structure. In fact, the RIB rate structure was seen as less of an incentive in 2017 than it was in 2012.

In the 2017 survey, customers previously aware of the RIB rate were more likely than others to have completed a home energy efficiency upgrade in the previous three years, to have participated in at least one of BC Hydro's conservation programs, and to have outperformed other customers on many in-home conservation behaviours. However, it could not be ascertained through the research if and to what extent awareness of the rate structure led to the decisions to engage in these activities.

Customer support of BC Hydro's RIB rate decreased from 59 percent to 55 percent between 2012 and 2017. Support continues to measure highest among customers who never incur Step 2 electricity consumption in a fiscal year.

Findings

Price Elasticity

1. The overall average Step 1 price elasticity was estimated to be -0.14 for F2016 and F2017. Previous analyses, covering the time period of F2005-F2012 and F2005- F2015, were unable to detect Step 1 price elasticity, likely due to relatively low Step 1 prices and small changes in the Step 1 price in earlier years. As a result, Step 1 price elasticity was assumed to be zero in the calculation of energy savings for F2013 to F2015, which was the same approach used in the 2013 Evaluation.

2. Step 2 price elasticity was estimated at -0.08, which is at the low end of the range from the previous evaluation (-0.08 to -0.13). This result may suggest that customer response to the Step 2 price has diminished over time.

3. A range of -0.08 to -0.14 was adopted to estimate natural conservation due to general rate increases under a flat rate in F2016 and F2017. This range spans the empirical estimates for Step 1 and Step 2 price elasticity for F2016 and F2017. In the absence of empirical estimates of flat rate and Step 1 price elasticities in the F2013-F2015 period, the planning assumption of -0.05 was applied for natural conservation in those years.

4. To obtain a proxy estimate of the flat rate elasticity, an analysis of residential consumption data from F2005 to F2016 in New Westminster, a jurisdiction serviced under a flat rate, was conducted. However, it did not produce a statistically significant estimate of flat rate elasticity.

Conservation Impacts of the RIB Rate

5. The annual incremental structural savings from the RIB rate were evaluated at 23 GWh, 3 GWh, and 13 GWh between F2013 and F2015.

6. Given the range of estimated flat rate elasticity due to general rate increases, (-0.08 to -0.14), definitive results for natural conservation and RIB structural savings in F2016 and F2017 could not be determined. Calculated RIB structural savings in F2016 and F2017 decreased as the flat rate elasticity increased. As a result, RIB structural savings in F2016 and F2017 were deemed to be small or zero.

Differences in Price Elasticity by Customer Characteristics

7. Price elasticity by region: Step 1 price elasticity was detected in three out of four geographic regions compared to none in the previous evaluation[5]. Step 2 price elasticity was detected in one region compared to all four regions in the previous evaluation. These results indicate that the Step 2 price is no longer a strong factor in determining electricity consumption in a large part of BC Hydro's service area.

8. Price elasticity by dwelling type: Step 1 price elasticity was identified in four dwelling types compared to none in the previous evaluation. Relative to the previous evaluation, Step 2 price elasticity decreased among single family dwellings and increased among row or townhouses and apartments.

9. Price elasticity by space heating type: Step 1 price elasticity was detected in households with electric and non-electric primary space heating, contrary to the previous evaluation. Step 2 price elasticity was only detected in households with non-electric primary space heating, and at a lower level than in the previous evaluation. The previous evaluation detected Step 2 price elasticity in both types of households. This finding suggests that energy savings induced by price changes from F2013 forward may have come from sources other than electric space heating.

[5] BC Hydro (2014)

10. Price elasticity in winter vs. summer: The analysis found no statistically significant difference in Step 1 price elasticity between winter and summer and a difference of -0.05 in Step 2 price elasticity—with elasticity being more negative in winter than in summer. This result indicates that for Step 2 consumption, the price sensitivity and price impact are greater in winter than in summer.

Customer Response, Awareness, and Understanding

11. From F2013 through to F2017, the proportion of customer households that incurred at least some Step 2 electricity consumption remained generally even at 70 percent. Through these five years, however, there was a decrease from 30 percent to 22 percent in the proportion that were into Step 2 in each month of a fiscal year.

12. Between 2012 and 2017, there was an increase from 53 percent to 64 percent in the proportion of customers who felt that BC Hydro's residential electricity prices were too high. Furthermore, the extent that customers felt this way was highly correlated with their exposure to Step 2 electricity consumption.

13. For customers that never incurred electricity consumption beyond Step 1, there was no longer a majority in 2017 – as there was in 2012 – who felt that prices were 'about right'. The largest segment of these customers now believed prices were too high. Their beliefs around the price of electricity in each of the 2012 and 2017 surveys help to explain why a Step 1 price elasticity was not detected until F2016 and F2017 as customers became increasingly responsive to increases in the Step 1 price.

14. Customers' unaided awareness that BC Hydro charges household consumption of electricity on an inclining block rate has gone generally unchanged over the past five years, measuring 49 percent in 2012 and 47 percent in 2017.

15. For customers previously aware of the RIB rate in each of the 2012 and 2017 surveys, their total bill amounts emerged as serving more of an incentive to manage their consumption of electricity than did electricity prices or the rate structure. In fact, the inclining block rate was considered to be less of an incentive in 2017 than it was in 2012, which is consistent with the findings regarding price elasticity and conservation.

16. Customers previously aware of the RIB rate in the 2017 survey were more likely than others to have completed a home energy efficiency upgrade in the previous three years, to have participated in at least one of BC Hydro's conservation programs, and to have outperformed them on many in-home conservation behaviours. However, it could not be ascertained through the research if and to what extent awareness of the rate structure led to the decisions to engage in these activities.

17. The total proportion of customers who support the RIB rate – including those who may have learned about it for the first time in the survey – has decreased from 59 percent to 55 percent over the past five years. Support continues to measure highest among customers who never incur Step 2 electricity consumption.

Recommendations

1. Consider whether the existing rate structure continues to serve BC Hydro's business objectives and meet customer needs, given that the current RIB rate structure appeared to yield little or no energy savings in F2016 and F2017.

2. Given the finding that larger consuming customers are more price responsive in the winter than in summer, consider exploring the value of a seasonal rate, with different pricing and consumption thresholds in the winter.

3. Consider the value of targeting small electricity consumers (e.g. those living in apartments) with existing or new DSM program offers, given their increased response to price changes in recent years.

Conclusions

Although awareness of the RIB rate has remained relatively unchanged over the past five years at just under 50 percent among all residential customers, the survey analysis has shown that a greater proportion of small customers now feel that electricity prices are too high and the econometric analysis has indicated that they have become more responsive to price changes.

Overall, the RIB rate appears to have achieved its objective of encouraging conservation through the customer response to higher marginal prices. However, the effectiveness of the RIB rate in yielding electricity savings appears to have diminished over time.

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1.0 Introduction

The Residential Inclining Block (RIB) rate is a two-step rate, where BC Hydro's residential customers who take electricity service under this rate pay a lower price for electricity consumption below a 1,350 kWh bi-monthly threshold and a higher price for electricity consumption above the kWh threshold.

1.1 Evaluation Scope

The previous evaluation of the RIB rate was conducted in 2013 and evaluated the price elasticity of consumption and the electricity conservation impacts in response to the rate's two-step structure, as well as customer awareness, understanding, and response to the RIB rate for the period October 2008 through March 2012 (the mid-point of F2009 through F2012). This evaluation is a continuation of the 2013 evaluation, and covers April 2012 through March 2017 (F2013-F2017).

1.2 Organization of Report

The organization of this report is as follows. Section 1 covers the evaluation scope, the organization of the report and the initiative description. Section 2 discusses the approach to the evaluation, including evaluation objectives, methodology review, data sources and methods. Section 3 provides the results organized by evaluation objective. Section 4 provides the findings and recommendations. Section 5 provides the conclusions. Additional supporting material is included in the appendices.

1.3 RIB Rate Overview

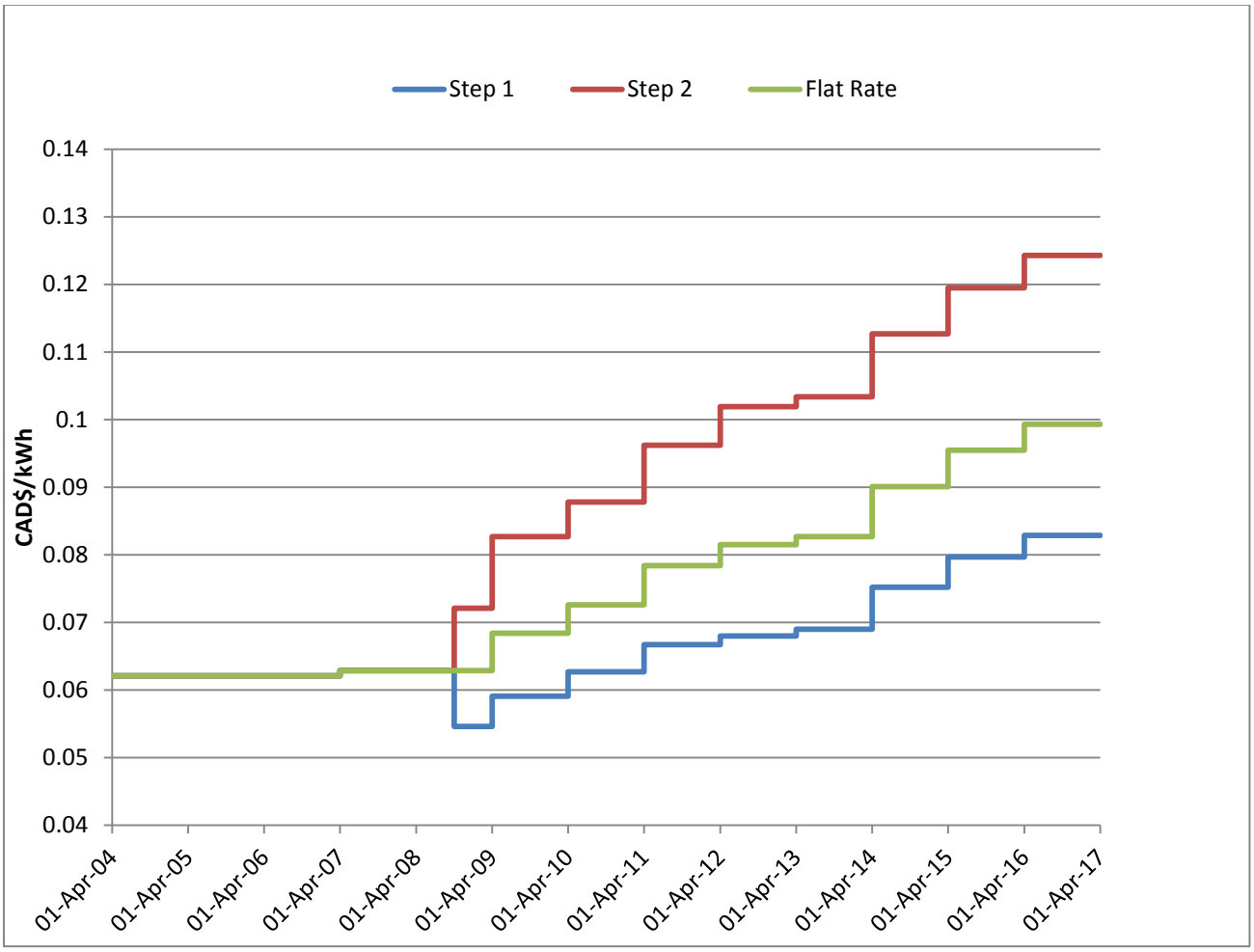
The use of conservation rate structures is one of three tools used in BC Hydro's Demand Side Management (DSM) Plan, the other two being energy efficiency programs and support for government codes and standards. The overarching objective of the RIB rate was to use price to encourage additional electricity conservation relative to what was achievable through a flat rate structure. This objective was supported by the inclining block rate design, where customers are billed at a lower (Step 1) rate for consumption below the 1,350 kWh threshold in a bi-monthly billing period, and at a higher (Step 2) rate for consumption above the threshold, thus setting a higher marginal price for large users relative to the flat rate they were billed at before the introduction of the RIB rate. Theoretically, the energy consumption of customers who rarely or never exceed the threshold may increase under this rate structure, since the Step 1 price was initially lower than the previous price. However, given that only approximately 20 percent of marginal consumption under the RIB rate was priced at Step 1, it was expected that any additional consumption by Step 1 customers would be offset and surpassed by the energy savings achieved by customers with Step 2 consumption, who were charged at a higher marginal price.

In August 2008 the British Columbia Utilities Commission (BCUC) determined that it was in the public interest for BC Hydro to implement the new RIB rate and required the new RIB rate structure to go into effect October 1, 2008 for approximately 1.6 million residential customers[6]. The Step 1 to Step 2 threshold was set at 1,350 kWh per bi-monthly billing period, approximately 90 percent of the median consumption of BC Hydro's residential customers. The 2 step price was gradually increased over time until it reached BC Hydro's estimated long run marginal cost of new energy supply. The Step 1 price was set residually to achieve revenue neutrality for the residential class.

[6] Certain residential groups were exempt from the RIB rate and continued to be charged under a flat rate, referred to as rate schedule 1151 in the BC Hydro tariff. The exempt group included farms and customers in the Bella Bella region.

Figure 1.1 below shows the nominal price changes in the RIB Step 1 and Step 2 prices, as well as the flat rate[7] that would have continued in the absence of the RIB, from F2005 through F2017.

Figure 1.1: RIB and Residential Flat Rate Energy Prices, F2005-F2017



The table below summarizes the energy prices charged to customers under the RIB rate between F2013 and F2017, and the ratio between step 2 and step 1 prices.

Table 0.1: Residential Inclining Block Rate Energy Prices between F2013 and F2017 (Nominal Dollars)

Price	F2013	F2014	F2015	F2016	F2017
Step 1 Price (¢/kWh)	6.8	6.9	7.52	7.97	8.29
Step 2 Price (¢/kWh)	10.19	10.34	11.27	11.95	12.43
Step 2 : Step 1 Ratio	1.5	1.5	1.5	1.5	1.5

Parallel Initiatives: The RIB rate operated in parallel to a number of residential DSM initiatives that were delivered to residential customers and may have had impacts on electricity consumption. These initiatives included energy efficiency programs and government codes and standards. The impact evaluation

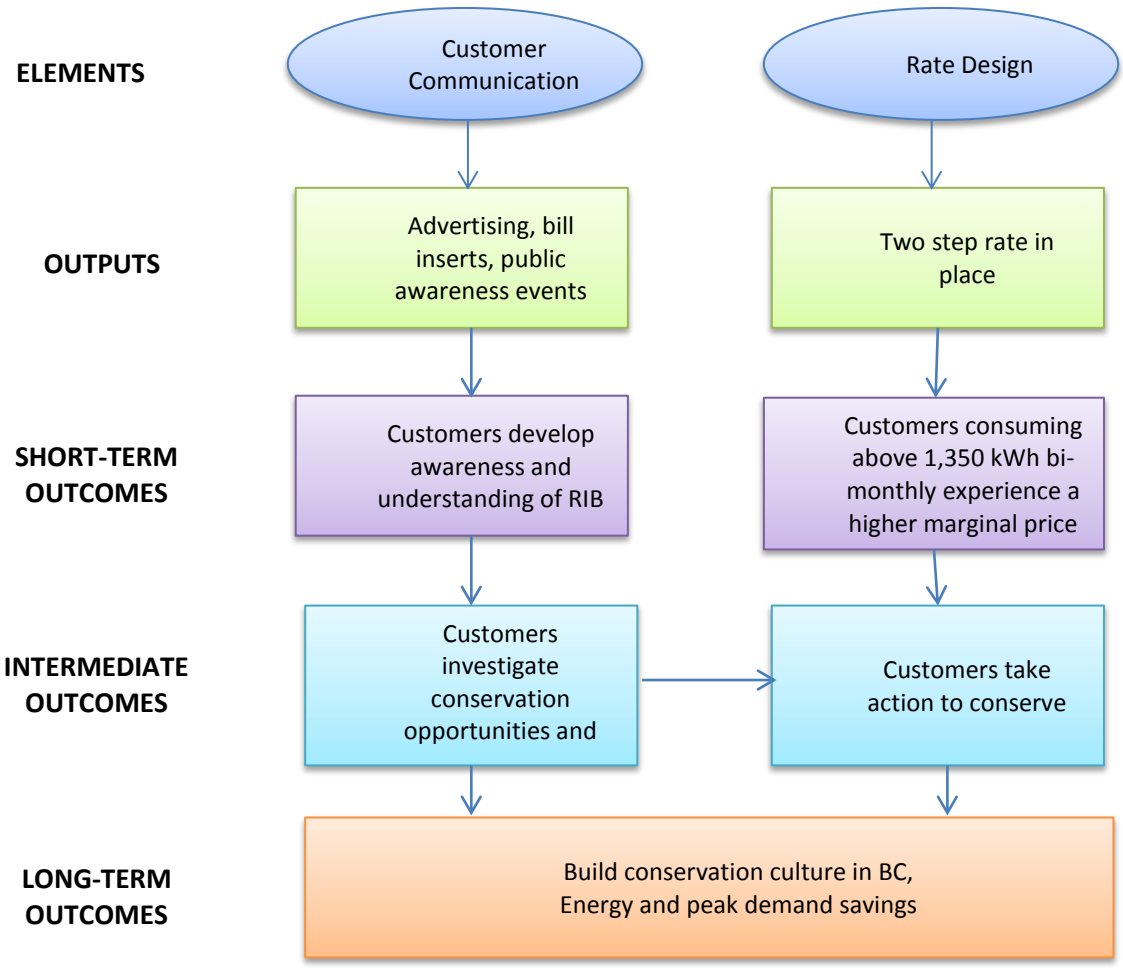
[7] The flat rate price changes included in Figure 1.1 refer to rate schedule 1151. The 1151 flat rate price was considered a proxy for what customers on the RIB rate would have been charged without the implementation of the RIB rate.

methodology used in this evaluation of the RIB accounted for the effect of these parallel DSM initiatives. Evaluated savings for the RIB do not include savings resulting from the parallel DSM initiatives mentioned above[8].

Program Logic Model: The RIB rate, through its price signals, was intended to encourage the adoption of conservation actions and encourage participation in BC Hydro's residential energy efficiency programs by improving the payback on conservation investments. Conversely, the presence of BC Hydro residential energy efficiency programs and educational initiatives was expected to elevate customers' awareness and understanding of the RIB rate, and enhance their response to the rate's price signals.

The logic model presented in Figure 1.2 illustrates how the RIB rate works toward energy conservation by dividing the initiative into its main elements or activities, and examining the logic chain for each element or activity.

Figure 1.2: RIB Logic Model



[8] The econometric analysis tests the sensitivity and influence of DSM programs and code and standard savings on the estimate of the RIB price elasticity and concludes that they do not affect the elasticity estimate. See Appendix D for the detailed econometric modelling results.

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2.0 Approach

2.1 Evaluation Objectives

The overall objective of this study is to evaluate the customer response to the RIB rate and to estimate energy and peak demand savings resulting from the rate. Table 2.1 summarizes BC Hydro's evaluation objectives and research questions to be addressed.

Table 2.1: Evaluation Objectives and Research Questions

Objectives	Research Questions
1. Estimate Price Elasticity	• What is the price elasticity of Step 1 and Step 2 consumption? • Is there a difference in price elasticity between BCH customers and a comparable community without a RIB rate (e.g. New Westminster)? • What is the price elasticity due to natural conservation, as measured by the price response to general rate increases through F2017? • How do the results of research questions related to price elasticity compare to previous research on this topic conducted as part of the last RIB rate evaluation?
2. Estimate the Conservation Impacts of the RIB Rate	• What are the energy savings due to BC Hydro's RIB Rate from F2013 to F2017? • What are the peak demand savings due to BC Hydro's RIB rate from F2013 to F2017? • What are the energy savings due to natural conservation from F2013 to F2017, as measured by the price response to general rate increases?
3. Analyze Differences in Price Elasticity by Customer Characteristics	• Are there differences in price elasticity by region? • Are there differences in price elasticity by dwelling type? • Are there differences in price elasticity by space heating type? • How do the results of research questions related to price elasticity compare to previous research on this topic conducted as part of the last RIB rate evaluation? • Are there differences in price elasticity between winter and summer periods?
4. Evaluate the Customer Response and Understanding of the RIB Rate	• Are there differences in the characteristics or demographics of customers who are never billed in Step 2 compared to those who are sometimes or always billed in Step 2? • What is the level of customer awareness and understanding of the RIB rate? • To what degree do customers believe electricity prices provide an incentive to manage electricity consumption? • To what extent do customers believe the total electricity bill amount provides an incentive to manage electricity consumption? • What is customers' understanding of their prevailing electricity price under the RIB rate structure? • To what extent do customers believe the RIB provides an incentive to manage electricity consumption? • To what extent do RIB aware customers report energy conserving behaviors as compared to non-RIB aware customers? • To what extent do RIB aware customers report implementing longer term capital investment in energy efficiency or conservation as compared to non-RIB aware customers? • Was program participation in DSM programs different between customers aware / not aware of the RIB rate? • Did low income customers have a different perception or response to the RIB Rate? • Does the RIB rate have any impact on customers' decisions on fuel switching from electricity to thermal fuels? • Is the RIB rate perceived as a barrier to electrification? • Has customers' response/acceptance to RIB changed over time? • Do customers support the RIB rate? • Do notifications / alerts on Step 2 have an impact on customers' consumption behavior? • How do the results of research questions related to customer response and understanding of the RIB rate compare to previous research on this topic completed as part of the last RIB rate evaluation or REUS surveys?

2.2 Methodology Review

A literature review of electricity rate studies in DSM evaluation resources and the academic literature shows that most evaluations have been focused on the estimation of price elasticity of various rate schemes and energy or demand impact by rate design. This methodology review briefly discusses the methodologies employed in the studies or evaluations of electricity rates and the learnings gleaned for the purpose of selecting a methodology for this RIB rate evaluation.

The methodologies for evaluating rate design vary in terms of evaluation methods and data construction. These methodologies are designed to address different evaluation questions and can be classified broadly into three types: 1) qualitative study through customer surveys to assess customers' perception, acceptance and behavioral responses to the rate design, 2) quantitative evaluation of rate impacts through estimation of price elasticity, and 3) experimental or quasi-experimental design to estimate the impacts of the different rate designs on electricity consumption.

The first type of methodology is designed to gauge customers' perception and response to electricity rate design. This type of evaluation is usually conducted through surveys of a representative sample of customers. This methodology is not widely used for rate evaluations due to customer privacy issues and evaluation budget constraints. For its conservation rate evaluation, FortisBC (2014) surveyed some customers with above average electricity consumption to assess their demographic information and energy uses. Sacramento Municipal Utility District (Potter J.M. et al., 2014) also conducted customer surveys to inform its SmartPricing evaluation and to assess customer's acceptance of potential changes to its pricing plan.

The second type of methodology involves quantitative study of rate impacts on electricity consumption. Such studies mainly entail econometric analysis to estimate price elasticity—the most commonly used measure in the electricity industry when analyzing consumption changes due to rate adjustments. It provides a straightforward and easy-to-compare means to measure the price impacts on electricity consumption and the magnitude of customers' price sensitivity. Many different techniques for econometric modelling of price elasticity have been developed to treat different research issues and/or address technical shortcomings. The methodology selected is often based on the specific market conditions and available data. Most elasticity studies adopt parametric models, which are based on economic and energy consumption theories. The following examples are the econometric studies of electricity price elasticity which use parametric models:

- Fullerton T. Jr et al. (2016) estimated both short-run and long-run residential price elasticity in El Paso, Texas for the period of 1977-2014,
- Ros (2015) estimated electricity price elasticity in the USA residential, commercial and industrial sectors,
- Sacramento Municipal Utility District (SMUD) in 2014 employed econometric models to estimate price elasticity for its SmartPricing evaluation, and
- Miller and Albernini (2016) provided a comprehensive review of elasticity analyses.

Other elasticity studies adopt non-parametric models which do not have a pre-defined model specification and provide an estimation of price elasticity based on a more flexible functional form. These models are often selected when estimates of price elasticity are thought to have changed over time[9].

The third type of methodology is experimental or quasi-experimental design. These methods rely on comparative analysis between a control group and a customer group that participated in a rate design. This method requires careful selection of the control or comparison group prior to the implementation of the rate

[9] Xiao et al. (2007) used non-parametric Bayesian model to estimate price elasticity of electricity demand and compared it to the results from parametric models.

design to ensure the comparability between the two groups. Faruqui et al. (2016) used a quasi-experimental design for an impact evaluation of a Time-of-Use rate in Ontario.

2.3 Methodology

The methodology adopted to evaluate the customer response to the RIB rate and the rate-induced conservation impacts has two parts. The first part is an estimation of the conservation impacts of the RIB rate via econometric modeling of price elasticity for each of the step 1 and step 2 price. Econometric models are selected as they provide a straightforward way to measure customers' price sensitivity and the resulting impacts on electricity consumption.

The second part evaluation method used surveys of a sample of RIB rate customers. A well designed survey with good sample coverage will provide accurate information on customers' perception and response to the RIB rate with high internal and external validity. The surveys also provide information or evidence that cannot be obtained from econometric analysis. The two methods are complementary and produce multiple lines of evidence and more valid and rich evaluation results.

Table 2.2 summarizes the data sources and methods employed in this study for each evaluation objective. Further description of the proposed methodology is provided in the subsequent sections, in order of evaluation objective. Alternative methodologies that were considered for this evaluation are presented in Section 2.4.

Table 2.2: Summary of Evaluation Objectives, Data Sources and Methodology

Evaluation Objective	Data Sources	Methods
1. Estimate Price Elasticity	• BC Hydro billing data from April 2004 to December 2016, including electricity consumption, space heating fuel, region and dwelling type by account • BC Hydro residential rate prices from April 2004 to December 2016 • BC Hydro DSM expenditures and savings, from 2004 to 2017 • Statistics Canada Consumer Price Index data from April 2004 to December 2016 • BC real disposable income from April 2004 to December 2016 from BC Stats • Heating and cooling degree days by region from April 2004 to December 2016 • New Westminster customer billing data from 2005 to 2016 and customer information on heating fuel and dwelling type	• Econometric modelling of price elasticity
2. Estimate the Conservation Impacts of the RIB Rate	• Data and results from Objective 1 • BC Hydro residential rate class load shape	• Calculation based on price elasticity and rate class load shape
3. Analyze Differences in Price Elasticity by Customer Characteristics	• Same as Objective 1	• Same as Objective 1
4. Evaluate the Customer Response and Understanding of the RIB Rate	• 2012 customer survey (n = 2,468) • 2017 customer survey (n = 3,307) • 2014 Residential End-Use Study (n=7,318) • 2017 Residential End-Use Study (n=6,929) • BC Hydro billing data from F2012 and F2017 • Data on customer sign-ups for Step 2 alerts • BC Hydro residential DSM program tracking data	• Cross tabulations of survey responses • Linking of survey responses to respondent billing history • Difference in proportions z-tests • Difference of Means Tests using Analysis of Variance

The methodology employed ultimately provides an estimate of evaluated net savings. Electricity cross effects and natural conservation are accounted for within the evaluated savings results. The method is not able to provide an estimate of the magnitude of electricity cross effects or the persistence of energy savings over time. Natural gas cross effects were not evaluated.

2.3.1 Methodology to Estimate Price Elasticity

Estimating conservation of the RIB rate first required estimates of price elasticity that measured customers' responsiveness to changes in price of their electricity. Step 1 and Step 2 price elasticity was estimated separately by modelling Step 1 and Step 2 consumption using linear regression analysis. The analysis quantified Step 1 and Step 2 consumption as the average bi-monthly consumption per account among groups of RIB customers defined by different dwelling types, geographical regions and heating fuel sources. The analysis was conducted at the aggregate level instead of using customer-specific data for a representative sample of customers, mainly because BC Hydro does not maintain detailed information at the individual account level on factors affecting electricity consumption, such as occupancy, personal income and residential building characteristics. Lack of detailed information pertaining to individual accounts could potentially lead to sample selection bias and the adopted approach of conducting the analysis at the aggregate level avoids such problems.

The following steps were employed to create the econometric models:

1. Determine the explanatory variables expected to influence electricity consumption and obtain applicable data;
2. Develop a basic functional form of the regression model;
3. Develop and test alternative forms of the regression model;
4. Estimate the price elasticity for Step 1 and Step 2 consumption;
5. Estimate the price elasticity for the baseline (flat rate) scenario.

These steps are further described below.

Step 1: Determine the Explanatory Variables Impacting Electricity Consumption and Obtain Data

Many factors influence electricity consumption. It is important to capture the major factors in the regression models in order to isolate the relationship between price and consumption. Factors considered as explanatory variables include electricity prices, weather, seasonality, space heating fuel, dwelling type, region, DSM expenditure and economic factors. As discussed later, various interactions between some of the variables were also considered. This is the same suite of explanatory variables that were tested in the 2014 RIB Evaluation, which provides high comparability of the elasticity results with those from the previous evaluation.

DSM initiatives, namely BC Hydro DSM programs and government codes and standards, and their impacts were also considered in the price elasticity models. BC Hydro DSM expenditures and the energy savings attributed to programs and codes and standards were the variables tested in the price elasticity models to examine whether price elasticity estimates were impacted. Alternative models with different treatment of the DSM expenditure or savings variables were tested in Step 3.

See Appendix C for further information on the methodology and each of the expected drivers of consumption.

Step 2: Develop the Basic Functional Form of the Regression Model

The overall goal was to create a simple and transparent model that reasonably explained the changes in electricity consumption with respect to changes in electricity price over the time period of analysis. The basic

model postulates that electricity consumption is a function of electricity price, space heating fuel, dwelling type, geographic region, billing period, weather, and disposable income.

Equation 1 portrays the per account consumption regression estimated using the Ordinary Least Square method. This model represents the basic form of a double-log regression with the key explanatory variables expected to affect electricity consumption.

Equation 1

$$\ln(Consumption) = \alpha + \beta \cdot Heat + \gamma \cdot Dwelling + \delta \cdot BillingPeriod + \omega 1 \cdot CDD + \omega 2 \cdot HDD + \text{ʒ} \cdot Region + \varepsilon \cdot ln\,(Price) + \sigma \cdot ln\,(Disposable\_Income) + \varphi \cdot C + \mu$$

Where,

ln() denotes natural logarithm; natural logarithm is used for convenience, because when it is used for both the consumption and price variables it results in a regression coefficient on the price variable that can be interpreted as an elasticity without additional calculation;

Consumption is average bimonthly electricity consumption per account in kWh;

Heat is a binary indicator (dummy variable) whose value is one to indicate the presence or zero to indicate absence of electricity as the primary space heating fuel;

Dwelling is a dummy variable to indicate different residential dwelling types: single family dwelling, apartment, row house, and mobile home;

BillingPeriod is a dummy variable that represents the six bimonthly billing periods in a calendar year to capture non-weather related seasonal effects;

CDD and *HDD* represent cooling and heating degree days, respectively, which are used to represent weather impacts;

Region is a dummy variable to represent the four regions in BC Hydro's service territory: Lower Mainland, Vancouver Island, Southern Interior, and North;

Price is the real electricity price charged to residential customers. It was a single flat rate before RIB and the applicable marginal rate in the RIB period. Price elasticity is represented by the coefficient (ε) for the price variable;

Disposable_Income: per capita real disposable income (CPI deflated);

C is a correction term to account for customer selection bias[10] caused by the fact that the Step 1 regression sample is made up of customers who only had Step 1 consumption in a given billing period and the Step 2 regression sample is made up of customers who had Step 2 consumption in a given billing period.

μ is the error term.

[10] See Heckman (1979) discusses sample selection bias and related specification error. See Havranek et al. (2012), Woo and Train (1988) and Yoo et al. (2007) for the examples of using the correction term to address sample selection bias.

Electricity consumption data was drawn from BC Hydro billing records for all RIB accounts from April 2004 to December 2016 (F2005 through Q3 of F2017). The analysis commenced in early 2017 when the complete data for F2017 was not yet available.

The electricity consumption data was set up in a panel format consisting of the four regions, four dwelling types, and two space heating fuel types described above. This produced a total of 32 observations per billing period and 2,400 observations for the entire period in the regression analysis. The first four and a half years of consumption was under the flat rate schedule and another eight and one quarter years was under the RIB rate.

Step 3: Develop and Test Alternative Forms of the Regression Model

Alternative forms of the basic model were constructed to test and compare the modeling results. The alternative forms explored the effect of adding or removing explanatory variables not included in the basic form. The estimate of price elasticity and the sensitivity of the estimate with respect to DSM initiatives were explored.

The impact of DSM expenditures and savings were tested in two alternative models.

Equation 2

$$\ln(Consumption) = \alpha + \beta \cdot Heat + \gamma \cdot Dwelling + \delta \cdot BillingPeriod + \omega 1 \cdot CDD + \omega 2 \cdot HDD + \xi \cdot Region +$$
$$\theta \cdot ln\left(DSM_{Expenditure}\right) + \varepsilon \cdot ln\,(Price) + \sigma \cdot ln\,(Disposable\_Income) + \varphi \cdot C + \mu$$

Where

> $DSM_{Expenditure}$ is the real (CPI deflated) BC Hydro spending on DSM initiatives (programs, codes and standards, and sector enabling activities) in the residential sector.

Equation 3

$$\ln(Consumption + DSM\ Savings) = \alpha + \beta \cdot Heat + \gamma \cdot Dwelling + \delta \cdot BillingPeriod + \omega 1 \cdot CDD + \omega 2 \cdot HDD +$$
$$\xi \cdot Region + \varepsilon \cdot ln\,(Price) + \sigma \cdot ln\,(Disposable\_Income) + \varphi \cdot C + \mu$$

Where

> *DSM savings refer to electricity savings in BC generated by BC Hydro's DSM programs and government codes and standards in the residential sector.*

The results of the models described in Equations 2 and 3 were compared to determine whether omitting a DSM variable would introduce meaningful error or bias to the estimates of price elasticity. As shown in Appendix D, the results indicated that reliable price elasticity estimates were obtained even in the absence of a DSM variable being included in the model.

Adding interaction terms to the regression model was also considered. For example, the relationship between weather and heating fuel is expected to have a strong influence on overall consumption since households with electric heat would have higher consumption in colder weather compared to households with non-electric heat. The alternative models explored the effects of including and/or excluding variables for:

- Billing period;
- Interactions between space heating fuel and weather; and
- Interactions between dwelling type and weather.

The selection of the alternative forms of the model was based on tested economic theories of drivers of residential electricity consumption and appropriate statistical and diagnostic tests. See Appendix C for additional details on the regression models and Appendix D for the full output of regression results.

Another model was developed to identify the difference in price elasticities between summer (June, July, August) and winter (November, December, January, February) as shown in Equation 4 on the following page. This model is similar to Equation 1 but only applies to monthly consumption data of the summer and winter months.

Equation 4

$$\ln(Consumption) = \alpha + \beta \cdot Heat + \gamma \cdot Dwelling + \delta \cdot BillingPeriod + \omega 1 \cdot CDD + \omega 2 \cdot HDD + \text{ʒ} \cdot Region + \varepsilon \cdot \ln(Price) + \varepsilon 1 \cdot Season \cdot \ln(Price) + \sigma \cdot ln\,(Disposable\_Income) + \varphi \cdot C + \mu$$

Where,

> *Season* is a dummy variable with value being either 1 to represent winter months or 0 to represent summer months.

An interaction term $Season \cdot ln\,(Price)$ was included in the model to detect any different price influence on consumption. Its coefficient, $\varepsilon 1$, indicates any difference in price elasticity between the winter and summer months.

Steps 4: Estimate the Price Elasticity for Step 1 and Step 2 Consumption

To obtain separate Step 1 and Step 2 price elasticity estimates, RIB rate customers were separated into two groups in each billing period based on bi-monthly energy consumption. The threshold between Step 1 and Step 2 consumption is 1,350 kWh in a two-month period. All RIB rate customer accounts with consumption below 1,350 kWh in a given bi-monthly billing period were analyzed as the Step 1 group. All accounts with consumption above the 1,350 kWh threshold in a given bi-monthly billing period were separately analyzed as the Step 2 group. As such, individual customers may fall in either group in different billing periods, depending on their billed consumption for specific periods. Since the Step 1 regression sample only contains the aggregate consumption of "small" customers and the Step 2 regression sample only contains "large" customers in a given bi-monthly billing period, each of the two regression models contained a correction term (as shown in Equation 1) to correct for the sample selection bias of an individual account being included in the aggregate consumption of one group or the other. See Appendix C for additional details on the regression models and Appendix D for the output of regression results.

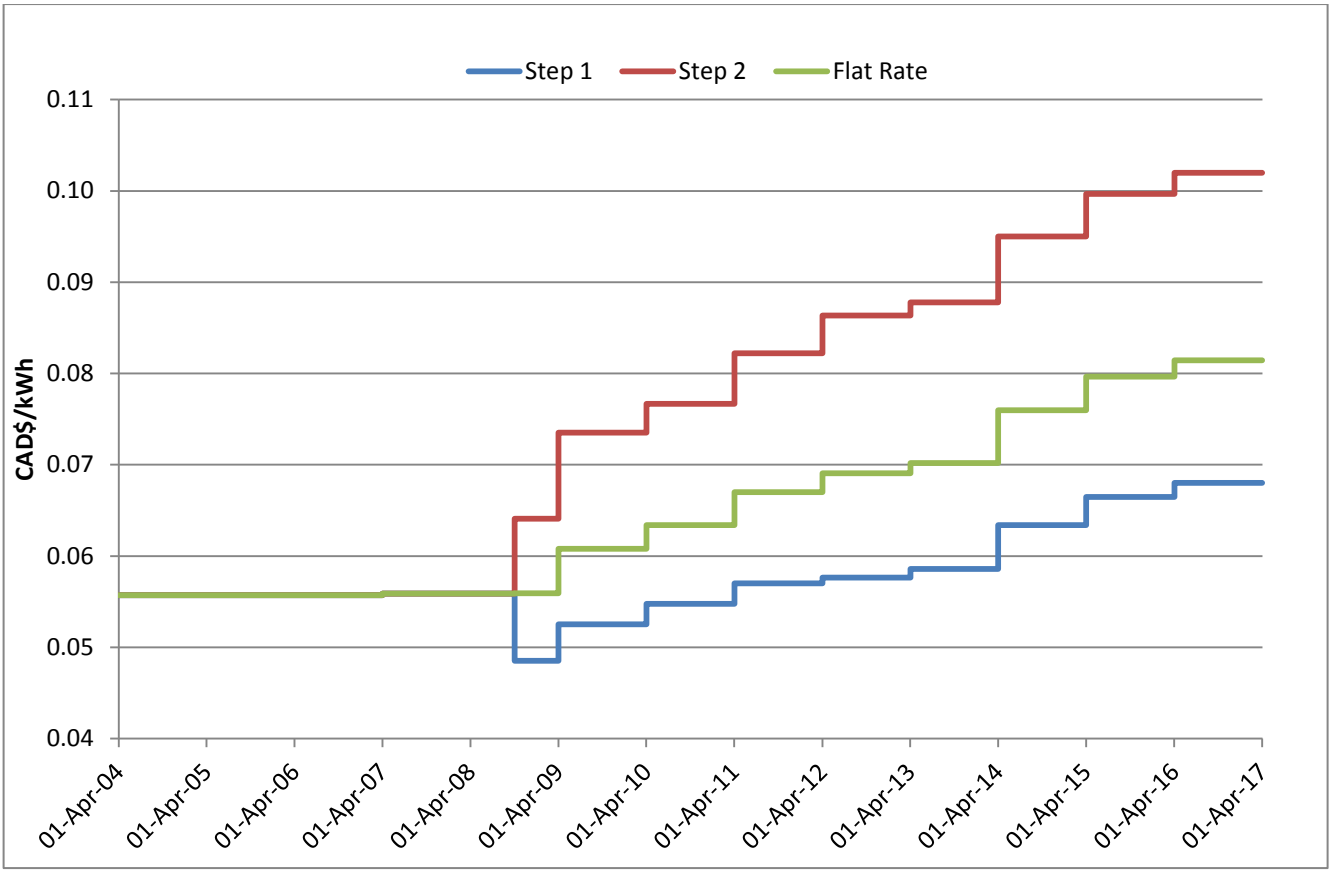
Step 5: Estimate the Price Elasticity for the Baseline Scenario

The baseline for estimating RIB rate savings was defined as a flat rate with general rate increases as per BC Hydro's approved Revenue Requirements Applications. Estimation of the price elasticity under a flat rate was required in order to estimate natural conservation due to general rate increases that would have occurred without the RIB rate structure.

BC Hydro's residential rate structure was switched from a flat rate to the RIB rate in October 2008. Since then, the flat rate has been applied only to specific customer groups under the 1151 Rate Schedule. The 1151 flat rate price was considered a proxy for what the customers on the RIB rate would have experienced without the implementation of the RIB from F2009 through F2017.

Figure 2.1 on the following page shows the real price changes after adjusting for inflation in Step 1, Step 2 and the flat rate from April 2004 (F2005) through to April 2017 (F2017).

Figure 2.1: Real Price Changes in the RIB and Residential Flat Rates after Inflation Adjustment (in 2002 dollar), F2005-F2017



The flat rate elasticity could not be empirically estimated. As a result, three options were considered for adopting a flat rate elasticity estimate. The first option was using the planning assumption of -0.05[11], which was adopted in the 2013 RIB rate application. The second option involved estimating flat rate elasticity by analyzing data from residents in New Westminster, which is another municipality in British Columbia. These customers were served by a different electric utility and charged under a flat rate. Any price elasticity estimated would then serve as a proxy for BC Hydro customers serviced under a flat rate. This analysis followed a method similar to that described in Step 1 through Step 3 above. The third option assumed that the flat rate elasticity falls somewhere in between the Step 1 and Step 2 price elasticities. This assumption was believed to be valid because the Step 1 and Step 2 price elasticity estimates are based on analysis of the same BC Hydro customers who would have been charged under a flat rate. In addition, the flat rate price falls within the range set by the Step 1 and Step 2 prices, and Step 1, Step 2 and the flat rate experienced the same annual price increases over the later part of the analysis period, as illustrated in Figure 2.1 above.

[11] Orans, R (2008), the source and reasons for adopting this assumption were provided in the expert testimony of the 2008 BC Hydro Long-Term Acquisition Plan.

2.3.2 Methodology to Estimate the Conservation Impacts of the RIB Rate

Energy and demand savings due to the RIB rate were calculated separately for Step 1 and Step 2 consumption, using the following steps, as described below:

1. Estimate total conservation for Step 1 and Step 2 consumption.
2. Estimate natural conservation under the baseline scenario.
3. Estimate structural conservation of the RIB rate as the difference between total and natural conservation.
4. Multiply total energy savings by a peak to energy ratio to estimate peak demand savings.

Step 1: Estimate Total Conservation

By definition, price elasticity multiplied by a percentage change in price yields the percentage change in consumption. The percentage change in consumption multiplied by the base year consumption gives the total change in consumption from the base year to the current year. For this evaluation, the percentage change in both Step 1 and Step 2 prices was defined as the percentage change in real price relative to the previous year. The method described in the 2008 RIB application[12] was designed to reflect estimated conservation over a phase-in period where the Step 2 rate was gradually increased, and it assumed that customer decisions were made relative to a price anchored in F2008. However, now that the RIB rate has been in place for more than nine years, it is reasonable to expect customers to adjust consumption based on the most recent price changes they experienced, rather than for example a price change relative to the flat rate that they were charged prior to the implementation of the RIB rate in 2008. This is the approach that was applied here, which is similar to what was done in the previous evaluation in 2013.

The impact of electricity consumption due to increases in each of Step 1 and Step 2 prices was calculated separately with the inputs of price elasticity and the previous year's consumption, as specified in the following equation:

Equation 5

$$\Delta\, kWh_t = \varepsilon_{price} \cdot \%\, \Delta price \cdot Electricity\ Consumption_{\,t-1}$$

Where:

$\Delta\, kWh_t$ is the consumption change (impact) in year *t* due to the change in price;

ε_{price} is the estimated price elasticity from the econometric models;

$\%\, \Delta price$ is the percentage change in real price relative to the previous year; and

ElectricityConsumption$_{t-1}$, for Step 1 impact, is the total consumption in the previous year from customer bills that do not exceed 1,350 kWh in any billing period. For Step 2 impact, it is the total consumption in the previous year from customer bills that exceed 1,350 kWh (including the first 1,350 kWh of electricity consumption per billing period billed at Step 1 price).

Total conservation is calculated as the sum of Step 1 and Step 2 impacts based on Equation 6:

[12] BC Hydro (2008) "Residential Inclining Block Application".

Equation 6

$$Total\ RIB\ Conservation\ Impact = \varepsilon_{Step\ 1\ price} \cdot \%\ \Delta Step\ 1\ price \cdot Step\ 1\ Electricity\ Consumption_{t-1} + \varepsilon_{Step\ 2\ price} \cdot \%\ \Delta Step\ 2\ price \cdot Step\ 2\ Electricity\ Consumption_{t-1}$$

Step 2: Estimate Natural Conservation

Calculations of natural conservation were based on Equation 5 with inputs of total (actual) residential sales charged at the RIB rate, the changes in the price for the 1151 Rate Schedule, and the flat rate elasticity.

Step 3: Estimate Structural Conservation

The natural conservation impacts were subtracted from the total conservation as a result of the RIB rate to arrive at the consumption impacts attributable to the structure of the RIB rate.

Equation 7

$$RIB\ Structure\ Impact = (Total\ RIB\ Conservation\ Impact - Natural\ Conservation\ Impact)$$

Step 4: Estimate Peak Demand Savings

Peak demand savings for the RIB rate were estimated by multiplying RIB structure energy impact, in GWh, by a peak-to-energy ratio based on the residential rate class load shape. This calculation assumes that RIB rate savings have the same shape as the total electricity consumption of the residential rate class.

2.3.3 Methodology for Analyzing Differences in Price Elasticity by Customer Characteristics

To further understand price responsiveness of different groups of customers, the data were partitioned by region, space heating fuel and dwelling type. The regression models (Equation 1) for Step 1 and Step 2 consumption used the different subsets of data to evaluate the price elasticity of different groups. The results for these models are presented in Section 3.

2.3.4 Methodology to Evaluate Customer Response and Understanding of the RIB Rate

Examination of the customer response and understanding of the RIB rate relied on customer survey data and billing data. RIB rate customer surveys were administered in January/February 2012 and in July/August 2017 to collect and track information on awareness, understanding and decision making related to the RIB rate, opinions on electricity pricing, behaviors around energy use, as well as additional demographic and housing parameters to inform the evaluation.

For the 2017 survey, a self-administered methodology – with online and print booklet options – was selected to afford respondents the time to formulate and express well considered responses to the number of complex questions being asked of them. Specifically, all randomly sampled customers were first mailed an invitation letter that served to introduce the study and to encourage their early participation in the survey by completing it online. Customers who had not completed the survey online by a specified date were then mailed a survey booklet with the option of either mailing it back in the business reply envelope, or completing it online. Lastly, customers who still had not completed the survey by a subsequent date were mailed a reminder card as a final attempt to promote participation.

The administration of the 2012 survey was very similar to that of the 2017 survey in that respondents had the two different ways of completing the survey. However, it did not utilize an initial invitation letter, and instead led directly with the survey booklet – with the option to complete online – followed by the reminder card.

The population of interest for both surveys was defined as the approximately 1.7 million customer households in BC Hydro's service territory with a residential account charged on the 1101 tariff, thereby excluding those residential in the non-integrated areas who are not charged under the RIB rate. Representative random samples of 10,000 customers were drawn from the overall population in BC Hydro's billing system with the survey correspondence subsequently sent to their households.

The 2017 survey's final sample was comprised of 3,307 customer respondents (1,792 online and 1,515 booklets) who not only completed the full survey, but also granted permission for their responses to be linked to their account history – a prerequisite for the survey analysis presented herein. This total translated to a 33 percent response rate and, at the 95 percent confidence level, a maximum margin of error of ± 1.7 percent.

The 2012 survey's final sample was comprised of 2,468 customer respondents (1,621 online and 857 booklets). This total translated to a 25 percent response rate and, at the 95 percent confidence level, a maximum margin of error of ± 2.0 percent.

Each of the two survey samples were statistically weighted by primary account holder age, housing type and region to their known population distributions to further ensure that findings were generalizable to the entire customer base of interest. These three parameters were chosen because many key areas of interest in the survey were proven to be highly correlated with them and because they are in fact among the very few parameters whose population distributions can be ascertained from the BC Hydro billing system.

Findings from BC Hydro's 2014 and 2017 Residential End-Use Studies were leveraged – due to their very large sample sizes and representativeness – to serve as population proxies in confirming the reliability of the RIB survey samples.

Refer to Appendix C for additional details on the RIB customer surveys, the Residential End-Use Studies as well as the statistical tests used in the analysis. Refer to Appendix D for the detailed RIB survey results and Appendix E for the RIB survey instrument.

2.4 Alternative Methodologies

This section describes alternative methods that were considered and rejected for this evaluation.

An intervention model is a linear regression model of bi-monthly residential electricity sales that includes a RIB rate indicator (dummy) variable to indicate the presence of the RIB rate beginning in October 2008 along with all other expected drivers of electricity consumption as described in Section 2.3.1. Theoretically, this method can produce direct estimates of the RIB rate's average conservation impact over the analysis period. However, it cannot produce a price impact for each year, nor can it take advantage of year-over-year price changes to estimate price elasticity. Since it does not produce an estimate of price elasticity, this method did not meet all the evaluation objectives and it was not adopted. Preliminary investigation into this method indicated that statistically significant savings induced by the RIB rate existed.

An experimental design using a control group was considered to estimate the flat rate elasticity as a baseline elasticity. A small number of BC Hydro residential customers that volunteered to participate in a Conservation Research Initiative ("CRI") Pilot in 2006 were excluded from the RIB rate in 2008 in order to form a control group. Preliminary analysis of customer characteristics indicated that CRI Pilot participants were not representative of the general population of RIB rate customers, so the experimental design method was rejected and further analysis was not pursued. BC Hydro dissolved the control group in 2017 with the approval of the BC Utilities Commission. As a result, a control group for the RIB rate no longer exists.

A second group of New Westminster electricity customers, who pay for their electricity under a flat rate structure, was analyzed to see if it could offer a proxy estimate of flat rate elasticity among BC Hydro

customers. The econometric analysis of this group did not yield statistically significant estimates of price elasticity under a flat rate.

A separate analysis of billing data at the level of individual customer accounts for a sample of 1,000 randomly selected customers was also considered. The price elasticity estimated from such a sample of customers should be representative of the overall population. This method was rejected due to the lack of necessary and detailed demographic, socio-economic and end-use data at the individual customer level.

2.5 Uncertainty and Threats to Validity

Uncertainty and Threats to Validity: Estimates of Price Elasticity and Conservation Impacts

The method adopted for this evaluation is mainly an analysis of electricity consumption and the underlying factors driving consumption changes. As the consumption model could be specified in different functional forms, different model specifications could lead to different price elasticity estimates. The accuracy of a price elasticity estimate depends on the appropriateness of the econometric model and the availability of information and data that can be applied to the model. Models with an over-simplified specification or missing critical variables or models with irrelevant variables can both lead to biased estimates of price elasticity.

The models adopted in the evaluation cover the most important factors that influence electricity consumption to avoid biased modelling results. To address the potential for bias of price elasticity estimates, this evaluation tested alternative forms of the models, including the inclusion or exclusion of DSM savings and expenditures, to examine if such variables affect the price elasticity estimates. For this reason, the internal validity of the elasticity estimates is considered high. The external validity of Step 1 and Step 2 price elasticity estimate is also considered high given that the data used for the analysis covers the entire residential class.

The accuracy of Step 1 and Step 2 price elasticity is considered high and so are the estimates of the Step 1 and Step 2 rate impacts. However, the ability to attribute conservation effects directly to the RIB rate (an aspect of internal validity) is considered moderate as the validity of the estimate of conservation under the baseline flat rate scenario is moderate. The accuracy of the impact evaluation with this method also depends on the accuracy of the baseline or counterfactual: how much electricity would have been consumed in the absence of the RIB rate? This is difficult to estimate because it is a hypothetical scenario. This evaluation produced a range for flat rate elasticity in F2016-F2017 based on the Step 1 and Step 2 price elasticity estimates. This range was then used to estimate the conservation effects which would have occurred in the absence of the RIB rate. However, because a precise estimate of flat rate elasticity was not empirically derived, the precision of the natural conservation impact, based on the range estimate of flat rate elasticity, is not high. Prior to F2016, a planning assumption was used for flat rate elasticity, which was in turn an input into the estimation of natural conservation. As a result there is greater uncertainty associated with the estimate of natural conservation in F2013 to F2015 compared to F2016 to F2017. This in turn affects the certainty of the RIB conservation impact estimate, which has been identified as a limitation in this evaluation.

Uncertainty and Threats to Validity: RIB Surveys

The main threats to the validity of the data collection approach and accompanying findings are tied to two concepts: 1) response bias, and 2) non-response bias and representativeness.

Response bias can occur when the structure of the survey, the presentation of information in the survey, the survey questions and/or the response options influence the responses of customers away from accurate or truthful responses. This potential source of bias was mitigated by administering what is believed to be well-structured, well-ordered, unambiguous and non-leading questions together with balanced response scales that covered the potential range of customer opinion.

One particular type of response bias is ‘social desirability response bias’ whereby respondents provide answers that they believe an interviewer may want to hear and/or answers that they believe are consistent with the

preferred outcome of the study. This potential source of bias was mitigated by utilizing a self-administered survey approach rather than an interviewer led approach.

Non-response bias can occur when subjects comprising the final survey sample are significantly different in the key exploratory parameters of interest than eligible subjects in the same population who did not complete a survey. Among a host of other possibilities, these responders may be different than non-responders on these exploratory parameters because their demographic, geographic, attitudinal or behavioural makeup is different. This can render the survey sample not wholly representative of the population.

Proving the existence or non-existence of non-response bias in a survey sample requires either 1) a follow-up survey sample of the non-responders or 2) an understanding of the true population distribution of the exploratory parameters of interest. Follow-up surveys with non-responders are very rarely conducted because they often incur additional costs, extend research timelines, and most often come with their own group of non-responders. Having an understanding of the true population distribution of the exploratory parameters before embarking on a survey is generally rare – the absence of this information is the very reason for conducting the survey in the first place.

Non-response bias was mitigated by the fact that high response rates were achieved on the surveys – the higher the response rate and the greater the coverage of a survey across different groups of subjects in the population, the lower the chance that the survey sample and its findings are not wholly representative of the population. Acceptable levels of coverage or representativeness of the survey samples were also confirmed by comparing various distributions of non-exploratory parameters in those samples (e.g. region, housing type, account holder age, education, household income, etc.) to the known distributions in the population as revealed in the customer account billing system as well as the in the Residential End-Use Studies.

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3.0 Results

In this section results are organized in accordance with the evaluation objectives and research questions outlined in Table 2.1 of Section 2.1. These questions are answered using information derived from the data and methodology listed in Table 2.2.

3.1 Results for Evaluation Objective 1: Estimate Price Elasticity

Three different models[13] were explored to estimate Step 1 and Step 2 price elasticity. The price elasticity estimates from Model 1 were adopted for the calculation of RIB conservation impacts.[14] . The modelling results for all three models are listed in Appendix D.

3.1.1 Step 1 and Step 2 Price Elasticity

The previous RIB evaluation in 2013 was unable to detect Step 1 price elasticity in a statistically significant manner (at the 90% confidence level) and estimated Step 2 price elasticity to be in the range of -0.08 to -0.13 (at the 95% confidence level). In subsequent analysis in 2016 with additional data from F2013 through F2015, Step 1 price elasticity could still not be detected at the 90 percent confidence level. Step 2 elasticity was not analyzed for the period between F2005 and F2015. The current evaluation extended data up to F2017 and estimated Step 1 elasticity at -0.14 and Step 2 elasticity at -0.08 (both at the 95% confidence level or higher.)

Table 3.1: Step 1 and Step 2 Price Elasticity Estimates

Round	Time Series Analyzed	Step 1 Elasticity	Step 2 Elasticity
1	F2005-F2012	Not statistically significant	-0.08 to -0.13***[15]
2	F2005-F2015	Not statistically significant	Not analyzed
3	F2005-F2017	-0.14***	-0.08***

*** indicates the statistical significance at 95% confidence level or higher

Looking at the results of the 3 rounds of analysis shown in Table 3.1 above, the inability to estimate Step 1 price elasticity in rounds 1 and 2 is likely due to a number of factors, including a relatively low Step 1 price and relatively small changes in the Step 1 price in the F2005 to F2014 period (see Figure 2.1 in Section 2.3.1). In contrast, the current analysis had more data points and included later years when the Step 1 price experienced larger annual increases and reached higher levels. These results suggest that these latter differences in price were sufficient enough to trigger a customer response that could then be quantified by the analysis.

The 3 rounds of analysis were conducted at different points in time with slightly different model specifications. To test whether these differences in model specifications affected the analytical results, the round 3 Step 1 model was run with 2 sets of truncated data matching the time periods analyzed in the earlier 2 rounds: F2005 – F2012 and F2005 – F2015. Neither analysis produced a statistically significant estimate of Step 1 price elasticity.

Since the Step 1 price elasticity could not be detected until F2015, the estimate of -0.14 was deemed to be applicable only to F2016 and F2017. The alternative of applying the Step 1 price elasticity to the entire F2009 to F2017 period was considered but rejected due to the absence of a statistically significant estimate of Step 1 price elasticity in the first 2 rounds of analysis.

[13] See Equations 1, 2, and 3 in Section 2.3.1.

[14] Models 2 and 3 showed that DSM expenditures and savings either had no effect on the price elasticity estimate or had a coefficient with the wrong sign (e.g. positive or negative) which would bias the price elasticity estimate if left in the model. Model 1 did not have an independent variable for DSM expenditures or savings.

[15] BC Hydro (2014)

Except for this evaluation, no specific studies were found indicating that price elasticity changes over time or over a price range within a single electricity market. However, there are many studies indicating variation in price elasticity between electricity markets and across price levels and time.[16] Some academic and industry researchers have suggested that price elasticity could be non-linear within a single electricity market[17].

Model 1 estimated Step 2 price elasticity at -0.08. This estimate is at the low end of the range of price elasticity (-0.08 to -0.13) from the 2013 RIB evaluation. The latest result suggests that the customer response to the Step 2 price may have diminished with time. The current estimate indicates that in comparison to the earlier years of the RIB, customers who were exposed to Step 2 prices in recent years may have become less price responsive—measured by percentage change in consumption—to Step 2 price increases. It also indicates that their capacity and options to conserve energy while facing price increases may have been more limited in recent years. Meanwhile, Step 1 consumption has become more price sensitive in recent years.

3.1.2 Flat Rate Elasticity (Natural Conservation)

As discussed in Step 5 of Section 2.3.1, the current evaluation was also unable to produce a statistically significant estimate of flat rate elasticity and considered three options for flat rate elasticity: a) the planning assumption of -0.05, b) a proxy in the form of price elasticity in New Westminster which is served under a flat rate and c) a range of flat rate elasticity falling between the Step 1 and 2 price elasticity (e.g. -0.08 to -0.14, or a wider range if the confidence intervals on these point estimates are considered).

Option A is based on the RIB rate application in which the estimate of flat rate elasticity is low[18] and was adopted in the 2014 evaluation which was unable to produce a statistically significant estimate of flat rate elasticity. In the absence of an empirical estimate of flat rate elasticity and the Step 1 elasticity estimate being zero for the F2013 to F2015 period, the flat rate elasticity in this period is considered to be low and the planning assumption of -0.05 was applied to the F2013 to F2015 period.

With respect to option B, New Westminster is an urban municipality in the Lower Mainland with a population of approximately 70,000 that is served by a municipal electric utility and charged for electricity under a flat rate. Given the 2013 RIB evaluation was unable to produce a statistically significant estimate of flat rate elasticity among BC Hydro customers, BC Hydro attempted to estimate the flat rate elasticity among New Westminster's 32,000 residential customer accounts by analyzing their electricity consumption using the same approach as used in this evaluation. The analysis covered the period from 2005 to 2016. If the analysis was successful in producing a statistically significant estimate, the estimate could serve as a proxy for BC Hydro customers if the current evaluation was again unsuccessful in estimating flat rate elasticity in a statistically significant manner.

However, the analysis of New Westminster data did not produce a statistically significant estimate of flat rate elasticity. The flat rate elasticity estimate was -0.10 but with a low confidence level (p=0.13). This result indicated that the flat rate elasticity was in the vicinity of -0.10, but with a large error band. Other variables such as weather, dwelling type, and billing period were statistically significant drivers of electricity consumption. The results of the New Westminster analysis are provided in Appendix D.

With respect to option C, of adopting a range estimate for flat rate elasticity falling between -0.08 and -0.14, since the Step 1 price elasticity estimate of -0.14 was deemed to only be applicable to F2016 and F2017, the range of flat rate elasticity was similarly deemed to only apply to F2016 and F2017. This range estimate is considered reasonable because the range of flat rate elasticity is based on the empirically derived values for

[16] Chang (2016) constructed a time-series model to show that price elasticity of electricity consumption changes over time in four selected countries.

[17] See Alberini and Filippini (2011) and Yachew (2017) for the discussions that elasticity may change over price range and time.

[18] Orans, R (2008), the source and reasons for adopting this assumption were provided in the expert testimony of the 2008 BC Hydro Long-Term Acquisition Plan.

Step 1 and Step 2 price elasticity. Under a flat rate scheme, Step 1 and Step 2 consumption would be combined together and the flat rate elasticity would be collectively affected by both Step 1 and Step 2 price elasticity. Under the flat rate scenario, it is the same customers being analysed, therefore they would have experienced the same external factors (e.g. economy, weather, housing stock, percentage increases in electricity price each year etc.) and their price response would bear similarity to the Step 1 and Step 2 price response. This rationale lends support to the idea that the flat rate price elasticity should not fall too far from the verified Step 1 and Step 2 price elasticities.

3.2 Results for Evaluation Objective 2: Estimate the Conservation Impacts of the RIB Rate

As outlined in Steps 1 through 3 of Section 2.3.2, energy conservation is calculated separately for the impact of the Step 1 and Step 2 prices, natural conservation under the baseline scenario and the RIB rate structure.

Table 3.2 shows the annual changes in real prices for Steps 1, Step 2, and the flat rate. Refer to Table C.1 in Appendix C for the complete history of the rate schedule price changes since the beginning of the RIB Rate.

Table 3.2: Percentage Change in Real Prices (in 2002$)

Fiscal Year	Step 1	Step 2	Flat Rate
F2013	1.1%	5.0%	3.1%
F2014	1.6%	1.6%	1.6%
F2015	8.3%	8.3%	8.2%
F2016	4.8%	4.9%	4.8%
F2017	2.3%	2.3%	2.3%

The incremental structural savings from the RIB rate were evaluated at 23 GWh, 3 GWh, and 13 GWh between F2013 and F2015, as listed in Table 3.3. The calculations are based on the value of Step 1 elasticity (zero), Step 2 elasticity (-0.08) and flat rate elasticity (-0.05).

Table 3.3: RIB Rate Savings F2013-F2015

Fiscal Year	Step 1 Price Impact (GWh)	Step 2 Price Impact (GWh)	Natural Conservation (GWh)	RIB Structural Savings (GWh)
	A	B	C	(A + B - C)
Elasticity	**0.00**	**-0.08**	**-0.05**	-
F2013	-	49	24	23
F2014	-	16	13	3
F2015	-	74	62	13

After adopting a flat rate elasticity range (-0.08 to -0.14), natural conservation and RIB structural savings in F2016 and F2017 were also estimated as a range. Table 3.4 shows the calculation of natural conservation and RIB structural savings tested over four different flat rate elasticities within the range of estimates that were empirically verified for Step 1 and Step 2 price elasticity: -0.08, -0.09,-0.10 and -0.14. Based on this calculation, savings appear to decrease as flat rate elasticity increases. The evaluated RIB energy savings in F2016 and F2017 were deemed to be small or zero, as shown in Table 3.5.

Table 3.4: RIB Rate Savings F2016-F2017

	Step 1 Price Impact (GWh)	Step 2 Price Impact (GWh)	Natural Conservation (GWh)				RIB Structural Savings (GWh)			
	A	B	C				(A + B- C)			
Elasticity	**-0.14**	**-0.08**	**-0.08**	**-0.09**	**-0.10**	**-0.14**	**-0.08**	**-0.09**	**-0.10**	**-0.14**
F2016	26	45	60	67	75	104	11	4	(3)	(33)
F2017	13	23	29	33	37	52	6	2	(2)	(16)

Evaluated savings are lower than what has been reported for F2013 through F2017. Table 3.5 compares reported and evaluated savings from the RIB rate structure.

Table 3.5: Reported and Evaluated RIB Rate Savings

	Energy Savings (GWh)		Peak Demand Savings (MW)	
Fiscal Year	**Reported**	**Evaluated**	**Reported**	**Evaluated**
F2013	42	23	9	5
F2014	19	3	4	1
F2015	59	13	12	3
F2016	29	0 to 11	6	0 to 2
F2017	8	0 to 6	2	0 to 1

The evaluated peak demand savings, calculated using the peak-to-energy ratio of 0.205 MW/GWh derived from the residential rate class load shape, range from (7) MW to 6 MW during the evaluation period.

Two major factors contribute to the variance between reported and evaluated RIB rate savings. First, the Step 2 price elasticity of -0.08 (in absolute value) is less than the planning assumption of -0.1. Second, the flat rate elasticity values applied to F2016 and F2017 were higher (in absolute value) than the value used in the forecast of RIB savings (-0.05). These two reasons were the major factors contributing to the smaller savings attributed to the RIB.

3.3 Results for Evaluation Objective 3: Analyze Differences in Price Elasticity by Customer Characteristics

Price elasticity associated with different customer profiles or characteristics were further analyzed through econometric modelling by different customer segments. The analysis was broken down by region, dwelling type, and space heating fuel. Additional analysis also estimated the difference in price elasticity between winter and summer. Results are shown at the 95 percent confidence level. N/A indicates that the estimates were not statistically significant at the 95 percent confidence level.

3.3.1 Price Elasticity by Region

Price elasticity was analyzed separately for four different geographic regions in BC Hydro's service territory: Lower Mainland, Vancouver Island, Southern Interior and North. The Step 1 price elasticity estimate in each region is listed in Table 3.6. The previous evaluation was unable to detect Step 1 price elasticity in a statistically significant manner. The current evaluation was able to detect it in three out of four regions.

Table 3.6: Step 1 Price Elasticity by Region

Evaluation	Lower Mainland	Vancouver Island	Southern Interior	North
2013	N/A	N/A	N/A	N/A
2018	-0.22	-0.18	N/A	-0.23

Step 2 price elasticities by region are listed in Table 3.7. Vancouver Island was the only region where the Step 2 price elasticity was statistically significant. The current and previous evaluations indicated that Vancouver Island had the highest Step 2 price elasticity and this finding aligns with the survey results from both evaluations.

Table 3.7: Step 2 Price Elasticity by Region

Evaluation	Lower Mainland	Vancouver Island	Southern Interior	North
2013	-0.11 to -0.13	-0.15	0.08 to -0.12	-0.12 to -0.15
2018	N/A	-0.12	N/A	N/A

While the estimate of Step 2 price elasticity is significant in the BC Hydro service territory as a whole, when the analysis is conducted by region, Step 2 price elasticity is not statistically significant in 3 of 4 regions. The regional analysis indicates that price sensitivity to the Step 2 price has become unidentifiable or insignificant in many parts of BC Hydro's service territory, and that variables other than price have a stronger influence on electricity consumption in those regions.

3.3.2 Price Elasticity by Dwelling Type

Step 1 and Step 2 price elasticity for the four major dwelling types are presented in Table 3.8 and 3.9. Step 1 price elasticity by dwelling type could not be estimated in the previous evaluation, but was identified, with statistically valid estimates, in the current evaluation.

Table 3.8: Step 1 Price Elasticity by Dwelling Type

Evaluation	Single Family Dwelling	Row/Town House	Apartment	Mobile Home
2013	N/A	N/A	N/A	N/A
2018	-0.04	-0.14	-0.26	-0.12

Compared to the previous evaluation, there were changes in Step 2 price elasticity by dwelling type. Price elasticity decreased among Single Family Dwellings but increased among Row or Townhouses and Apartments.

Table 3.9: Step 2 Price Elasticity by Dwelling Type

Evaluation	Single Family Dwelling	Row/Town House	Apartment	Mobile Home
2013	-0.08 ~ -0.14	-0.06 ~ -0.07	-0.03 ~ -0.04	-0.10
2018	-0.08	-0.10	-0.07	-0.09

3.3.3 Price Elasticity by Space Heating Type

Step 1 and Step 2 price elasticity for two space heating types are presented in Table 3.10 and 3.11. The previous evaluation did not estimate Step 1 price elasticity by space heating type in a statistically significant manner. The current evaluation did. The higher elasticity value for non-electric heat suggests that the Step 1 price response comes not only from space heating but also from other end-uses.

Table 3.10: Step 1 Price Elasticity by Heating Type

Evaluation	Electric Heat	Non-electric Heat
2013	N/A	N/A
2018	-0.11	-0.18

Unlike in the previous evaluation, Step 2 price elasticity for electrically heated customers could not be identified in the current evaluation, which suggests that space heating may not be the major source of Step 2 price response among most Step 2 customers.

Table 3.11: Step 2 Price Elasticity by Heating Type

Evaluation	Electric Heat	Non-electric Heat
2013	-0.14	-0.08 ~ -0.09
2018	N/A	-0.17

3.3.4 Difference in Price Elasticity between Winter and Summer

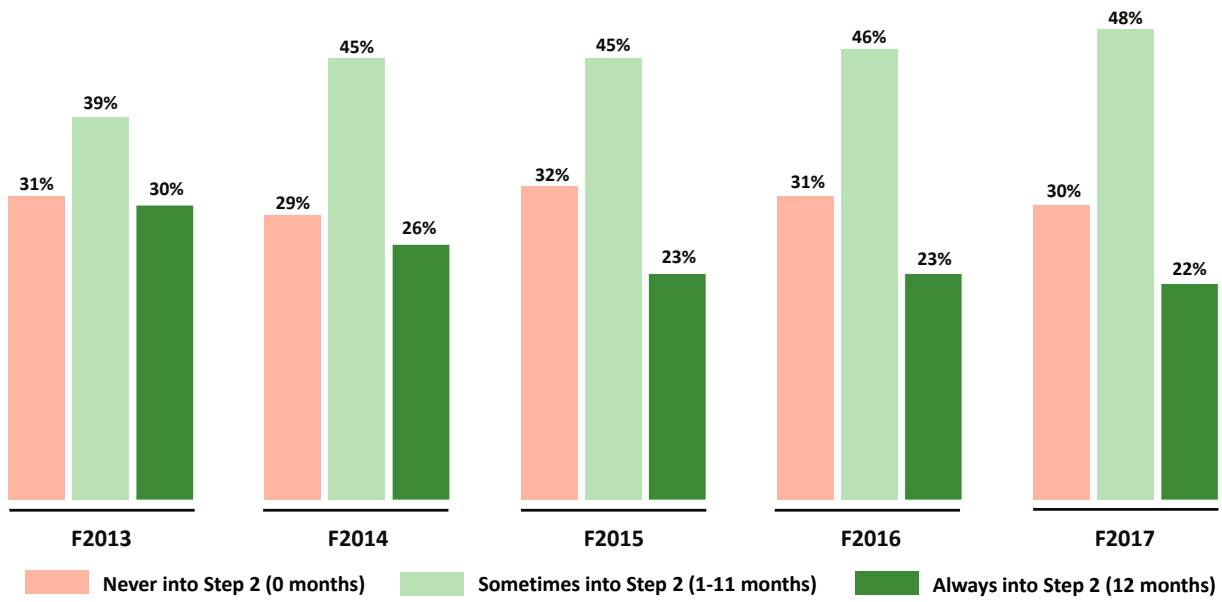
The econometric analysis of price elasticity differences between winter (November, December, January and February) and summer (June, July and August) shows no statistically significant difference in Step 1 price elasticity. For Step 2 price elasticity, the difference between winter and summer is -0.05, with Step 2 price elasticity more negative in winter than in summer. This result indicates that customers exposed to Step 2 consumption, are more price responsive in the winter compared to the summer. Due to the short time period and lack of contrast in consumption, the econometric modelling was unable to separately analyse the winter or summer period. Therefore, there was no separate estimate of winter or summer price elasticity. Based on the Step 2 elasticity estimate of -0.08 and the difference in elasticity between winter and summer of -0.05, it is expected that the Step 2 price elasticity estimate is in the vicinity of -0.05 in summer and in the vicinity of -0.11 in winter.

3.4 Results for Evaluation Objective 4: Evaluate Customer Response and Understanding of the RIB Rate

3.4.1 Customer Exposure to Step 2 Electricity Consumption

While the econometric models to estimate elasticity grouped all RIB rate customers into 'small' (Step 1 only) and 'large' (Step 2 only) consumption groups, much of the analysis presented herein uses three consumption bins to help further profile customers in terms of their exposure to Step 2 consumption through the evaluation period. For each fiscal year, Figure 3.1 details how RIB rate customers' electricity consumption distributed into the three unique consumption bins: the percentage of customer households that never (0 months), sometimes (1-11 months) or always (12 months) incurred Step 2 consumption in the twelve months of the fiscal year[19].

Figure 3.1
Incidence of Step 2 Electricity Consumption by Fiscal Year



Through the five fiscal years, the proportion of customer households that never incurred Step 2 consumption remained generally unchanged at approximately 30 percent. However, there was a change among the balance of customers in that there was an increase from 39 percent to 48 percent in the proportion that sometimes incurred Step 2 consumption while – accordingly – there was a decrease from 30 percent to 22 percent in the proportion that always incurred Step 2 consumption. The reasons for the changes are unknown, but they likely include those related to factors such as weather, changes in regulations, technological improvements, and conservation.

Incidence of Step 2 Electricity Consumption in F2017 by Region and Dwelling Type

Looking strictly at F2017, customer households on Vancouver Island were the most likely to have incurred Step 2 electricity consumption that year – 81 percent did so in at least one month of the year, including some 27 percent that always did so in all twelve months. As detailed in Appendix D, these findings reflect that nearly one-half of customers on Vancouver Island rely on electricity for both their space heating and water heating needs and that these end-uses were key determinants of Step 2 consumption.

[19] For each fiscal year, only accounts open the entire year were included in the analysis.

Customer households in the Lower Mainland were the least likely to have incurred Step 2 consumption in F2017 – only 64 percent did so in at least one month of the year. This finding is due in part to the fact the Lower Mainland is comprised of a much larger share of apartments and condominiums than other regions and the fact that these smaller dwellings – most without their own hot water heaters – are the least likely to incur any Step 2 consumption.

Table 3.12: Incidence of Step 2 Electricity Consumption in F2017 by Region and Dwelling Type

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total	Total Sometimes + Always into Step 2
Total	30%	48%	22%	100%	70%
Region					
Lower Mainland	36%	44%	20%	100%	64%
Vancouver Island	19%	53%	27%	100%	81%
Southern Interior	23%	53%	24%	100%	77%
North	22%	54%	24%	100%	78%
Dwelling Type					
Single detached house	17%	49%	34%	100%	83%
Duplex/Row house/townhouse	22%	64%	14%	100%	78%
Apartment/Condominium	65%	34%	1%	100%	35%
Mobile home/other	24%	58%	18%	100%	76%

Regional distributions are based on the billing system. Dwelling type distributions are based on the survey sample.
Row totals may not total 100% due to the rounding of values.

At 83 percent, customers living in single detached houses were the most likely to have incurred Step 2 consumption in F2017. This incidence measured slightly lower at 78 percent among customers living in duplexes, row houses or townhouses and at 76 percent among those living in mobile or other dwellings, but much lower at just 35 percent among those living in apartments and condominiums.

All of these particular patterns and differences in exposure to Step 2 consumption in F2017 – as well as those that tie to other parameters such as space heating and water heating fuels – are very similar to those first uncovered in the 2013 evaluation. Refer to Appendix D for the details pertaining to F2017.

3.4.2 Opinions of BC Hydro's Residential Electricity Prices

Several lines of questions in each of the 2012 and 2017 surveys focussed on customer opinions about the price of electricity and their electricity bills in the context of the RIB rate structure. However, in view of the possibility that not all customers think about the price of electricity in regards to the RIB rate, respondents were first asked – before seeing any RIB rate content – for their opinions about BC Hydro's residential electricity prices in a broader sense[20].

Opinion of BC Hydro's Current Residential Electricity Prices

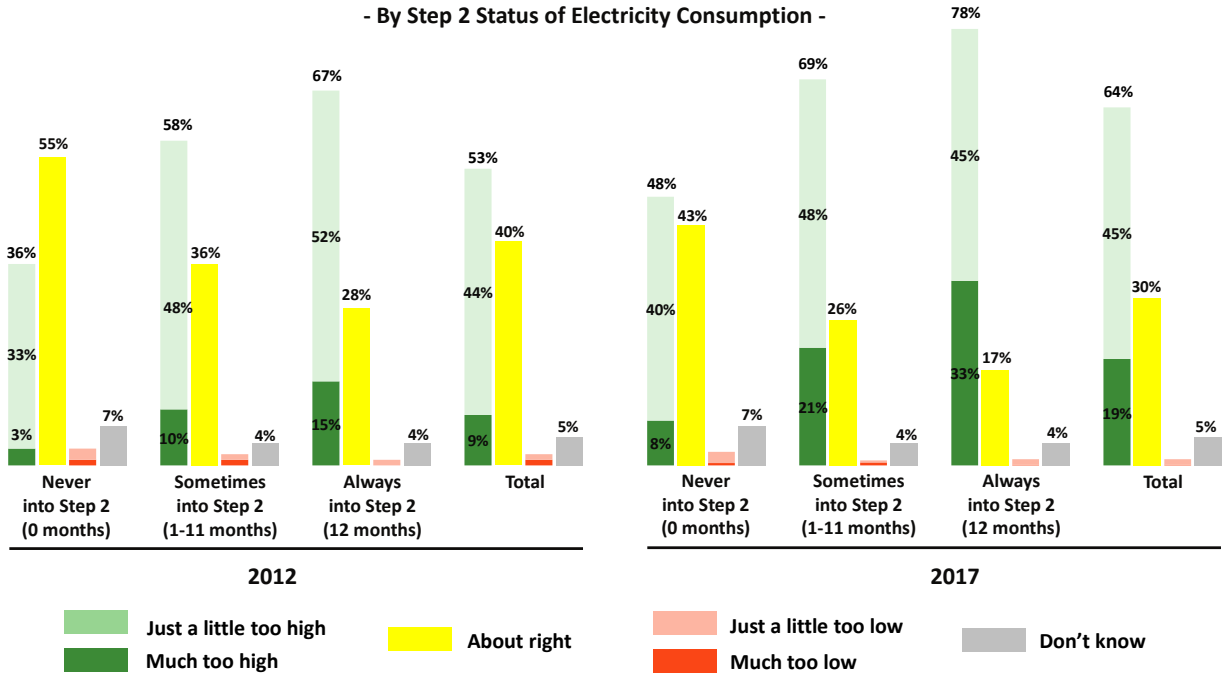
In the 2012 survey, 53 percent of customers felt that electricity prices were either 'just a little too high' or 'much too high', but this slim majority in sentiment increased to 64 percent in the 2017 survey.

In each of the two surveys, customer opinions of the current residential electricity prices varied strongly with their incidence of Step 2 electricity consumption. As illustrated in Figure 3.2 on the following page, for customers that never incurred Step 2 electricity consumption in F2012, the majority of them – 55 percent – felt

[20] Before being asked their opinion of electricity prices in the survey, respondents were first asked to rate the extent that the amount of money that their household pays for its consumption of electricity represented 'value for money'. In doing so, it is believed that their opinions about 'price' were comparably more considered and thoughtful than had the 'value for money' question not been asked.

that electricity prices were 'about right'. To compare, the proportion who felt this way measured much lower at 36 percent among households that sometimes incurred Step 2 consumption in the fiscal year and at 28 percent among households that always did so. For these two particular cohorts, the majority of customers felt that the current electricity prices were either 'just a little too high' or 'much too high'.

Figure 3.2
Opinion of BC Hydro's Current Residential Electricity Prices



The pattern of opinions toward electricity prices identified in the 2012 survey emerged again in the 2017 survey, but with some notable shifts over the five year period. In each of the three cohorts, there were increases in the proportion of customers who felt that electricity prices were too high – including doublings in those who felt that the prices were 'much too high'. Notably, for customers that never incurred Step 2 electricity consumption in F2017, there was no longer a majority who felt that prices were 'about right'.

These results may help to explain why Step 1 elasticity was not detected until the third round of analysis that included data for the years F2016 to F2017. Step 1 customers who felt that electricity prices were 'about right' would be comparably less likely to be responsive to price increases than those who felt that prices were already 'just a little too high' or 'much too high'.

Refer to Appendix D for additional findings in regards to customer beliefs in regards to price changes over the previous three years.

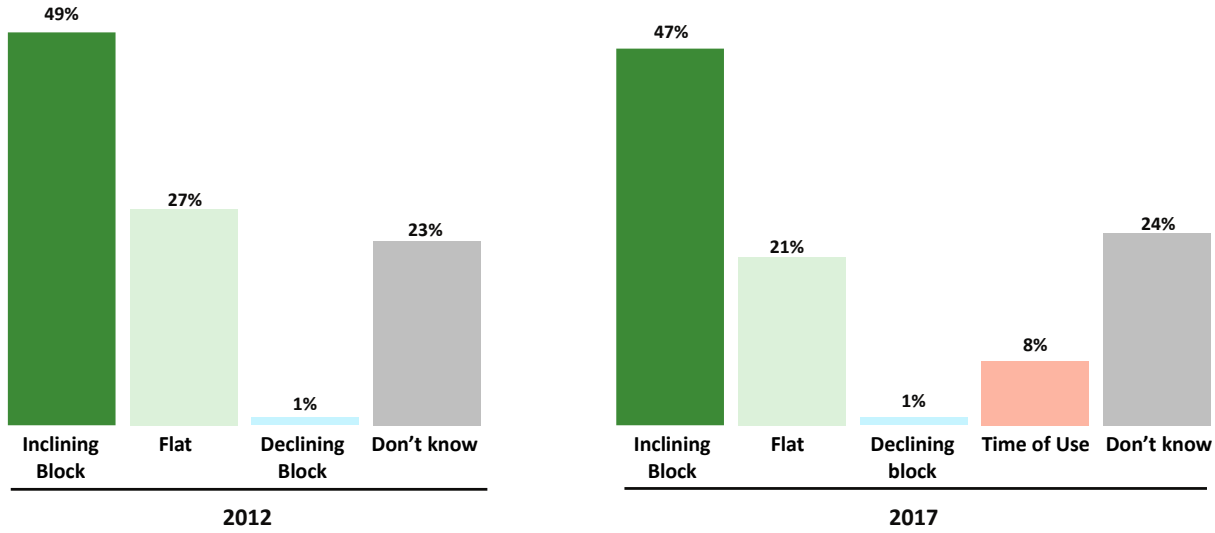
3.4.3 Awareness and Opinions of BC Hydro's Residential Rate Structure

Unaided Awareness of BC Hydro's Residential Rate Structure

To measure customers' awareness of BC Hydro's residential rate structure, a series of different rate explanations were presented in the survey and questions administered to derive their actual awareness prior to receiving the survey – that is, awareness uncontaminated by the survey content itself. It is also important to note that the context of interest was awareness of the rate structure in concept – not necessarily awareness by name such as the 'Residential Inclining Block' or the 'Two-Step Residential Conservation Rate'. Figure 3.3 on the following page details the findings pertaining to 2012 and 2017.

At 49 percent in 2012 and 47 percent in 2017, there has been no meaningful change over the past five years in the proportion of customer respondents who demonstrate a previous awareness that BC Hydro charges their household's consumption of electricity on an inclining block rate – also described as a stepped rate in the survey.

Figure 3.3
Perceived Rate Structure that BC Hydro Uses to Charge for the Consumption of Electricity



The proportion of customers who believed their household's use of electricity was charged on a flat rate has dropped from 27 percent to 21 percent over the past five years. The initial finding and subsequent decrease is likely due in part to the fact that customers were charged on a flat rate prior to October 2008 – presumably, some of these respondents thinking it was still in effect. However, this decrease is also likely due in part to the fact that a time of use rate response option was added to the 2017 survey and the finding that 8 percent of respondents believed their consumption was charged in this manner. In other words, data analysis showed that many of these individuals would very likely have selected the flat rate in the 2017 survey had the time of use rate not been added as a response option[21].

Unaided awareness that BC Hydro uses an inclining block rate to charge residential customers for their use of electricity continues to be strongly tied to household consumption – the pathway very likely being via the magnitude of the accompanying bills and the extent that customers would be motivated to understand them. At 53 percent, households that always incurred Step 2 consumption in the twelve months of F2017 were the most likely to have been aware of the structure. Awareness measured slightly lower at 49 percent among households that sometimes incurred Step 2 consumption in the year and much lower at 39 percent among those that never incurred Step 2 consumption.

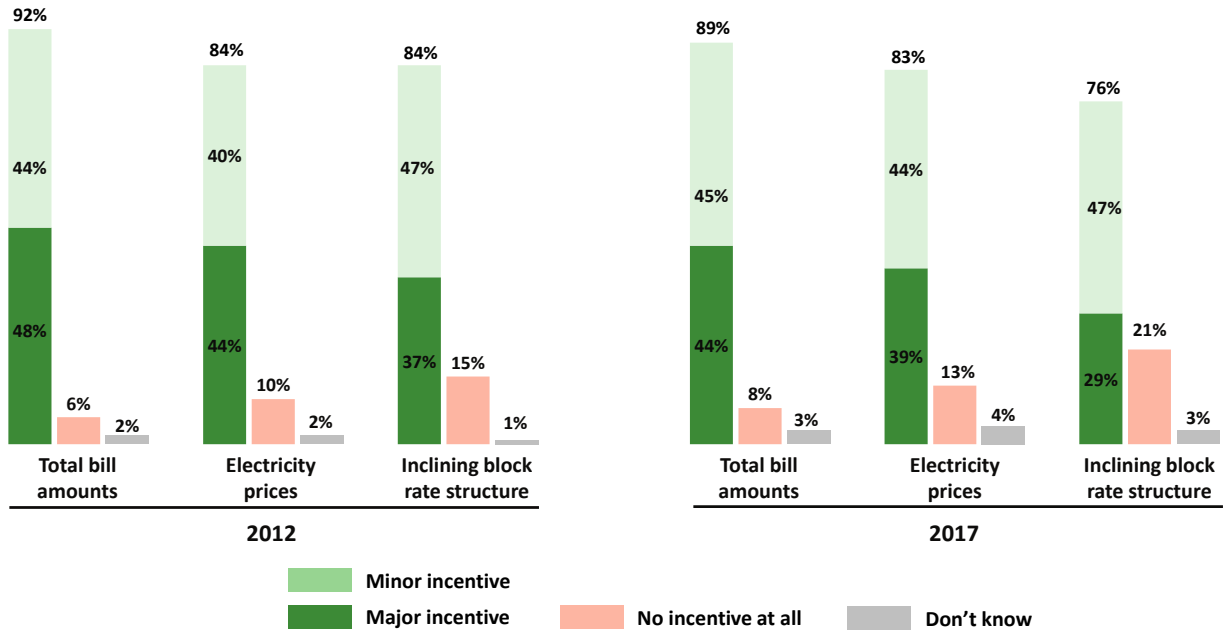
Refer to Appendix D for a complete accounting of rate awareness by all customer demographics and household sub-groups – including region, dwelling type, space heating fuel and water heating fuel.

[21] Data analysis showed that the addition of the time of use response option to the 2017 survey was not responsible for the 2-point decrease in the proportion of respondents who were coded as having a prior understanding that their consumption of electricity is charged on an inclining block rate. This is due to the rigor around the data analysis and the fact that many different lines of questions were administered in each of the 2012 and 2017 surveys to gauge and triangulate customer beliefs about the rate structure, including several strictly in regards to the inclining block rate.

Total Bill Amounts, Electricity Prices and the Inclining Block Structure as an Incentive to Manage Electricity

All customers were asked to consider – in separate lines of questions – the extent that electricity prices, their total electricity bills and the method they perceived BC Hydro uses for charging their household's consumption of electricity each served as an incentive to manage their use of it[22]. Figure 3.4 details findings from the 2012 and 2017 studies strictly among customers who correctly knew that their consumption of electricity was charged on an inclining block rate.

Figure 3.4
Extent that Total Bill Amounts, Electricity Prices and the Inclining Block Structure Serve as an Incentive to Manage Electricity
- among customer respondents with unaided awareness of BC Hydro's residential inclining block rate -



By virtue of the specific distribution of responses for each of the three factors, the total bill amounts emerged in the 2012 study as the greatest incentive to manage electricity among these customers followed by electricity prices and slightly further behind by the inclining block rate structure.

The hierarchy – the relative position of the three factors – identified in 2012 revealed itself as generally the same in 2017, but with some notable differences as detailed further below. Total bill amounts and electricity prices continued to sit in first and second position, respectively, though the specific proportion of customers assessing them as serving an incentive to manage electricity did slip marginally – the bill amounts from 92 percent to 89 percent, and the electricity prices from 84 percent to 83 percent.

The substantive change was in regards to proportion of customers who viewed the inclining block rate as an incentive to manage electricity – it decreased from 84 percent in 2012 to 76 percent in 2017. What's more, this 8-point decrease was seen entirely in the 'major incentive' response option which underscores the change in sentiment much more than had the decrease been – at least partially – in the 'minor incentive' option.

[22] In regards to electricity prices, customer respondents were reflecting on their own perception, understanding and experience with price without having been given any details about the inclining block rate – such as the Step 1 and Step 2 prices – that BC Hydro uses to charge their household for their consumption of electricity.

These changes in opinion have created sharper contrasts among the three incentive factors in 2017 than as seen in 2012. Most importantly, the inclining block rate was less seen as serving an incentive to manage electricity consumption – less in comparison to how it was viewed in 2012, and less than in 2012 in its relative comparison to total bill amounts and electricity prices.

Customer Opinion of the Price of Electricity in Relation to the RIB Rate

Customers who correctly identified that their household's use of electricity is charged on an inclining block rate may not necessarily consider or differentiate the price of electricity – as it pertains to their own household – by the Step 1 and Step 2 prices. Having been reminded that they are charged the Step 1 price for their consumption of electricity up to 1,350 kWh in an average two-month billing period and the Step 2 price for any additional consumption, these particular customers were queried in each of the 2012 and 2017 surveys as to what they considered to be their electricity price as it relates to their own household's use of it.

The single largest segment of these customers in 2017 – 46 percent – considered each of the Step 1 and Step 2 prices as being their household's price of electricity, depending on the point in time in the billing period and/or their consumption in the billing period. This is especially true for households that either sometimes or always incurred Step 2 consumption in the twelve months of F2017.

Table 3.13: Customer Opinion of the Price of Electricity in Relation to the RIB Rate - among customers previously aware of the RIB Rate in 2017 -

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total
I would say that I consider the lower, Step 1 price as being my household's price of electricity in a billing period	49%	15%	7%	22%
I would say that I consider the higher, Step 2 price as being my household's price of electricity in a billing period	4%	9%	14%	9%
I would say that I consider each of the Step 1 and Step 2 prices as being my household's price of electricity, depending on the point in time in the billing period and/or our consumption in the billing period	32%	52%	48%	46%
I do not think about my household's price of electricity in any of these particular ways	13%	22%	27%	21%
Don't know	2%	2%	3%	2%
Total	100%	100%	100%	100%

Column totals may not total 100% due to the rounding of values.
Binning of Step 2 status is based on electricity consumption in F2017.

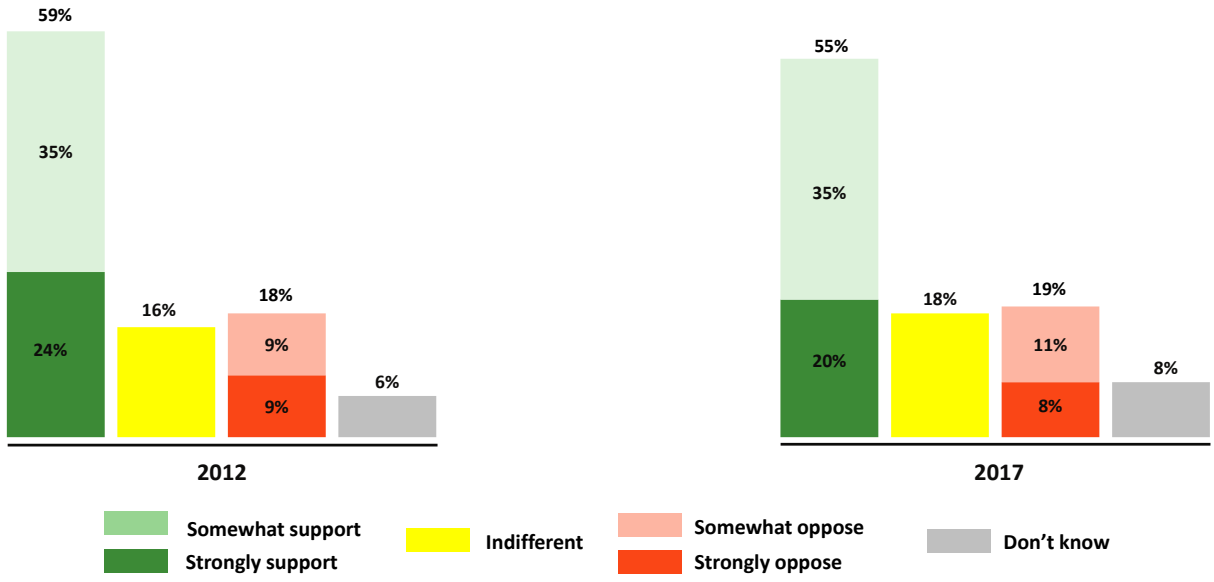
A total of 22 percent of customer contacts who correctly understood that their household's consumption of electricity is charged on an inclining block rate considered the lower, Step 1 price as being their household's price of electricity in a billing period. This sentiment increased substantially to 49 percent strictly among households that proved to have never incurred Step 2 consumption in F2017. Only a small minority of customers – 9 percent – considered the higher, Step 2 price as being their household's price of electricity in a billing period. The balance of most other customers – 21 percent – revealed that they do not think about their household's price of electricity in any of the three given ways.

A very broad view of these findings suggests that many of these customers who correctly identified that their household is on an inclining block rate have a logical understanding and view of the price of electricity. These results remain largely unchanged from the 2012 survey.

Customer Support of the RIB Rate

The total proportion of customers who support the RIB rate that BC Hydro uses to charge for their consumption of electricity – including those who may have learned about it for the first time in the survey – has decreased from 59 percent to 55 percent over the past five years. This 4-point decrease in support of the RIB rate has transferred to a 2-point increase to 18 percent in the proportion of customers indifferent about the rate and a 1-point increase to 19 percent in those opposed to it.

Figure 3.5
Customer Support of the RIB Rate



While the slip in support of the RIB rate does not mark a wholesale change in sentiment, it is statistically significant at the 99 percent level of confidence. This indicates that this change very likely occurred among the population of all RIB rate l customers – not just among those in the survey samples. Note also that this decreased support was detected in nearly all customer sub-groups (i.e. by region, dwelling type, etc.).

As found in the 2012 study, customer opinion of the RIB rate in 2017 was most correlated – and very strongly so – to their exposure to Step 2 electricity consumption. Support for the structure measured highest at 68 percent among customers who never incurred Step 2 consumption in F2017; many of them living in apartments or condominiums that often do not to breach the Step 2 threshold. Support measured much lower at 52 percent among households that sometimes incurred Step 2 consumption and at just 42 percent among those that always did so.

3.4.4 Customer Behaviour in Relation to Awareness of the RIB Rate

Electricity Consumption by Awareness of the RIB Rate

As first uncovered in the 2013 evaluation, average Step 1, Step 2 and total electricity consumption in F2017 measured higher among customer households aware of the RIB rate than among other households.

Table 3.14: ANOVA Tests: Mean Electricity Consumption in F2017 by Awareness of the RIB Rate

	Customers aware of the RIB Rate	Customers not aware of the RIB Rate	Difference between groups
Total F2017 consumption ⇒	10,447 kWh	8,707 kWh	1,740 kWh*
Total Step 1 consumption ⇒	6,305 kWh	5,777 kWh	528 kWh*
Total Step 2 consumption ⇒	4,142 kWh	2,930 kWh	1,212 kWh*

* The difference between mean consumption levels is statically significant at the 99% level of confidence.

Statistical analysis – namely, analysis of variance and linear regression – indicated a causal path whereby higher consumption leads to a greater likelihood of being aware of the rate. Refer to Appendix D for the details.

It is worthy to note that when comparing their consumption over time, households aware of the RIB rate may have lower energy consumption than had they not been aware of the rate and/or lower energy consumption than in periods prior to becoming aware of the rate.

Investments in Home Energy Efficiency Upgrades by Awareness of the RIB Rate

Customers in the 2017 survey were queried as to whether they had completed any home energy efficiency upgrades in the past three years to understand whether such investments differ by awareness of the RIB rate. Those who knew that their consumption of electricity was charged in this way were slightly more likely than others to have completed at least one of the eight upgrades investigated (52% vs. 48%), including more likely to have completed draft proofing upgrades (21% vs. 15%) and insulation upgrades (16% vs. 12%).

Table 3.15: Investments in Home Energy Efficiency Upgrades by Awareness of the RIB Rate

	Customers aware of the RIB Rate	Customers not aware of the RIB Rate	Difference between groups
	⇓	⇓	⇓
Net Total: Any of the upgrades	52%	48%	4 points*
Hot water tank installation/upgrade	30%	28%	2 points
Window upgrades	24%	22%	2 points
Draftproofing upgrades	21%	15%	6 points*
Door upgrades	17%	16%	1 point
Insulation upgrades	16%	12%	4 points*
Furnace installation/upgrade	12%	12%	0
Air source heat pump installation/upgrade	4%	3%	1 point
Ground source heat pump installation/upgrade	1%	1%	0

* Statistically significant difference between the two groups at the 95% level of confidence.

As expected, customers living in single detached or semi-attached houses were much more likely to have completed any of the upgrades than those living in apartments and condominiums. In fact, analysis showed that housing type, demographics such as income, attitudes toward energy efficiency, and awareness of the RIB rate are all factors that inform customers' likelihood of having completed such upgrades. However, due to the number of these factors and their interplay with each other, any causal relationship between awareness of the RIB rate and the decision to make such investments could not be effectively isolated and measured.

Program Participation by Awareness of the RIB Rate

BC Hydro offers several programs to its residential customers to encourage them to improve energy efficiency and to adopt more energy conscious behaviours in their homes. Customers who understood that their household's consumption of electricity is charged on the RIB rate emerged to be more likely than other customers to have participated in the Residential Behaviour Program (14% vs. 6%) and the Appliance Rebate Program (14% vs. 9%) since the rate came into effect in October 2008. In addition, these RIB aware customers were more likely to have signed-up on BC Hydro's website to be able to view their detailed electricity use by the month, week, day or even hour. Refer to Appendix D for the complete findings.

For the same reasons as given in the previous sub-section above, it could not be ascertained through the research if and to what extent awareness of the rate structure led to the decision to participate in the programs.

In-Home Behaviours by Awareness of the RIB Rate

The self-reported in-home behaviours around energy use and conservation were compared between customers who correctly understood that their household's use of electricity is charged on the RIB rate and those that did not. As found in the 2012 study, customers previously aware of the inclining block rate emerged to outperform other customers on many of the conservation behaviours related to space heating, laundry, dishwashing, lighting and other energy-using equipment.

Due to the interplay among customer demographics, attitudes toward energy efficiency, awareness of the RIB rate, etc., it was not possible to measure the causal pathway that may exist between awareness of the rate and the conservation behaviours.

Appendix D details the comprehensive list of in-home behaviours investigated in the survey, including the behavioural scores disaggregated by customers previously aware of the inclining block rate and all others.

Customer Behaviour and Electricity Consumption by RIB Step 2 Price Alerts

BC Hydro's billing system shows that a total of 5 percent of customer households have signed up online to receive email notifications that indicate when their consumption of electricity is halfway to reaching the higher Step 2 price in a billing period as well as when it has reached it.

Among these customers in the 2017 survey, 64 percent reported that they typically make more of an effort to manage their consumption of electricity when their household receives the price alerts – 35 percent do not.

In regards to the entire pool of customer households that received at least one Step 2 price alert in F2017, the analysis was not able to ascertain whether the alerts had an impact on their electricity consumption during the year.

However, for households that chose to act on the price alerts, various analyses showed – depending on the comparison scenario – that their Step 1 and/or Step 2 electricity consumption in F2017 was lower than other households. The differences were not statistically significant, however, largely because the absolute number of households in the survey that received the price alerts and acted on them was not large enough to afford a high level of confidence in the findings.

3.5 Confidence and Precision

Since the RIB conservation estimates are anchored in the estimation of price elasticity, the accuracy and confidence of the savings estimates depend on the statistical significance of the elasticity estimates. The Step 1 and Step 2 elasticity estimates have very high levels of precision (with very large t-values at the 99% confidence level). The results of the evaluated Step 1 and Step 2 price impacts have a high level of precision because they are based on the highly statistically significant Step 1 and Step 2 price elasticity estimates.

In comparison, the flat rate elasticity was not empirically derived. Instead, a planning assumption of -0.05 was applied to F2013 through F2015. For F2016 and F2017, the flat rate elasticity was estimated to fall within the range of the Step 1 and Step 2 price elasticity estimates. Due to the error band associated with the Step 1 and Step 2 elasticity estimates, the range of flat rate elasticity based on the Step 1 and Step 2 price elasticity estimates could be expanded to span, for example, the 95 percent confidence intervals of those estimates[23]. As such, the flat rate elasticity estimate is less precise than the Step 1 and Step 2 elasticity estimates because it would broaden the range of the RIB structural savings estimate, expanding it both on the positive and the negative sides and providing no more certainty over the existence of significant savings.

The calculation of natural conservation impacts are based on the flat rate elasticity planning assumption (F2013-F2015) and the flat rate elasticity range estimate with relatively low precision (F2016-F2017). Therefore, the precision of the natural conservation estimate is low. Hence, the precision of the estimated savings from the RIB rate structure, as the difference between the sum of the step rate impacts and the natural conservation impact, is moderate.

Shown below are the margins of error and the confidence levels associated with the 2012 and 2017 customer surveys used in this evaluation.

Table 3.16: Uncertainty and Margins of Error of the Survey Results

	Valid Responses	Maximum Margin of Error	Confidence Level
2012 Residential Rate Survey	2,468	± 2.0%	95%
2017 Residential Rate Survey	3,307	± 1.7%	95%

3.6 Limitations

This evaluation lacks the empirical evidence to estimate the flat rate elasticity. The certainty and precision of the evaluated conservation impact of the RIB rate is affected given that a planning assumption of the flat rate elasticity was applied to F2013 through F2015, and a range estimate was applied to F2016 and F2017.

The modelling of price elasticity also has some limitations. The current approach is limited by the availability and frequency of data. Disposable income data was only available on an annual basis while all other variables were available on a bi-monthly basis. The lower frequency and lack of variability in the income data may limit the model's ability to accurately estimate the income effect on electricity consumption. The econometric models were not able to identify the impact of energy efficiency improvements from government codes and standards on electricity consumption, as well as the impact of changes in household occupancy. A time variable which could represent these to a certain extent was tested but did not emerge as a statistically significant driver of electricity consumption.

The Step 1 price elasticity estimate in this evaluation was applied to the F2016-F2017 period only given that the analyses of previous time periods did not produce a valid Step 1 price elasticity estimate. There is a possibility that Step 1 price elasticity existed prior to F2016 but it could not be detected using the available data. This possibility is considered low but adds uncertainty to the estimate of Step 1 price elasticity. Customer survey evidence also indicated that the customer response to Step 1 was low in earlier years and has only increased in recent years.

The three rounds of Step 1 price elasticity analysis indicated that price response may change over time. However, the parametric model adopted in this evaluation alone was not able to provide direct support for non-linear price elasticity. This parametric model was based on a pre-defined consumption model, which does

[23] The range of the flat rate elasticity estimates would expand to -0.04 to -0.19 if the 95% confidence intervals of Step 1 and Step 2 price elasticity were considered.

not provide the flexibility to detect the time impact on other factors in the model (such as price elasticity or income elasticity). Any non-linear effect over time may be better estimated with a non-parametric model. However, it is not certain that a valid non-parametric elasticity model could be constructed, for the purposes of this evaluation, due to a lack of variation in the available data (e.g. income data).

As discussed in Section 2.3.1, the analysis of price elasticity was conducted at the aggregate level across all residential customers, and not at the individual customer level. It is difficult to produce more comprehensive and precise electricity consumption models at the aggregate level to better estimate price elasticity. More insights and better understanding of price elasticity could be obtained from analysis at the individual customer level, but that would require the availability of more customer-level data on end-use profiles and energy efficiency standards over the analysis period.

Finally, the use of an average peak-to-energy ratio based on the residential rate class load shape adds uncertainty to the estimates of peak demand savings. The econometric analysis is unable to determine how the customer response to the RIB rate translates into energy savings during the short time frame that defines the overall system peak.

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4.0 Findings and Recommendations

4.1 Findings

Price Elasticity

1. The overall average Step 1 price elasticity was estimated to be -0.14 for F2016 and F2017. Previous analyses, covering the RIB period of F2009-F2012 and F2009-F2015, were unable to detect Step 1 price elasticity, likely due to relatively low Step 1 prices and small changes in the Step 1 price in earlier years. As a result, Step 1 price elasticity was assumed to be zero in the calculation of energy savings for F2013 to F2015, which was the same approach used in the 2013 Evaluation.

2. Step 2 price elasticity was estimated at -0.08, which is at the low end of the range from the previous evaluation (-0.08 to -0.13). This result may suggest that customer response to the Step 2 price has diminished over time.

3. A range of -0.08 to -0.14 was adopted to estimate natural conservation due to general rate increases under a flat rate in F2016 and F2017. This range spans the empirical estimates for Step 1 and Step 2 price elasticity for F2016 and F2017. In the absence of empirical estimates of flat rate and Step 1 price elasticities in the F2013-F2015 period, the planning assumption of -0.05 was applied for natural conservation in those years.

4. To obtain a proxy estimate of flat rate elasticity, an analysis of residential consumption data from F2005 to F2016 in New Westminster, a jurisdiction serviced under a flat rate, was conducted. However, it did not produce a statistically significant estimate of flat rate elasticity.

Conservation Impacts of the RIB Rate

5. The annual incremental structural savings from the RIB rate were evaluated at 23 GWh, 3 GWh, and 13 GWh between F2013 and F2015.

6. Given the range of estimated flat rate elasticity due to general rate increases, (-0.08 to -0.14), definitive results for natural conservation and RIB structural savings in F2016 and F2017 could not be determined. Calculated RIB structural savings in F2016 and F2017 decreased as the flat rate elasticity increased. As a result, RIB structural savings in F2016 and F2017 were deemed to be small or zero.

Differences in Price Elasticity by Customer Characteristics

7. Price elasticity by region: Step 1 price elasticity was detected in three out of four geographic regions compared to none in the previous evaluation[24]. Step 2 price elasticity was detected in one region compared to all four regions in the previous evaluation. These results indicate that the Step 2 price is no longer a strong factor in determining electricity consumption in a large part of BC Hydro's service area.

8. Price elasticity by dwelling type: Step 1 price elasticity was identified in four dwelling types compared to none in the previous evaluation. Relative to the previous evaluation, Step 2 price elasticity decreased among single family dwellings and increased among row or townhouses and apartments.

9. Price elasticity by space heating type: Step 1 price elasticity was detected in households with electric and non-electric primary space heating, contrary to the previous evaluation. Step 2 price elasticity was only detected in households with non-electric primary space heating, and at a lower level than in the previous evaluation. The previous evaluation detected it in both types of households. This finding

[24] BC Hydro (2014)

suggests that energy savings induced by price changes may come from sources other than electric space heating.

10. Price elasticity in winter vs. summer: The analysis found no statistically significant difference in Step 1 price elasticity between winter and summer and a difference of -0.05 in Step 2 price elasticity - with elasticity being more negative in winter than in summer. This result indicates that for Step 2 consumption, the price sensitivity and price impact are greater in winter than in summer.

Customer Response, Awareness, and Understanding

11. From F2013 through to F2017, the proportion of customer households that incurred at least some Step 2 electricity consumption remained generally even at 70 percent. Through these five years, however, there was a decrease from 30 percent to 22 percent in the proportion that were into Step 2 in each month of a fiscal year.

12. Between 2012 and 2017, there was an increase from 53 percent to 64 percent in the proportion of customers who felt that BC Hydro's residential electricity prices were too high. Furthermore, the extent that customers felt this way was highly correlated with their exposure to Step 2 electricity consumption.

13. For customers that never incurred electricity consumption beyond Step 1, there was no longer a majority in 2017 – as there was in 2012 – who felt that prices were 'about right'. The largest segment of these customers now believed prices were too high. Their beliefs around the price of electricity in each of the 2012 and 2017 surveys help to explain why a Step 1 price elasticity was not detected until the F2016 and F2017 consumption data was added to the econometric analysis.

14. Customers' unaided awareness that BC Hydro charges household consumption of electricity on an inclining block rate has gone generally unchanged over the past five years, measuring 49 percent in 2012 and 47 percent in 2017.

15. For customers previously aware of the RIB rate in each of the 2012 and 2017 surveys, their total bill amounts emerged as serving more of an incentive to manage their consumption of electricity than did electricity prices or the rate structure. In fact, the inclining block rate was considered to be less of an incentive in 2017 than it was in 2012.

16. Customers previously aware of the RIB rate in the 2017 survey were more likely than others to have completed a home energy efficiency upgrade in the previous three years, to have participated in at least one of BC Hydro's conservation programs and to have outperformed other customers on many in-home conservation behaviours. However, it could not be ascertained through the research if and to what extent awareness of the rate structure led to the decisions to engage in these activities.

17. The total proportion of customers who support the RIB rate – including those who may have learned about it for the first time in the survey – has decreased from 59 percent to 55 percent over the past five years. Support continues to measure highest among customers who never incur Step 2 electricity consumption.

4.2 Recommendations

1. Consider whether the existing rate structure continues to serve BC Hydro's business objectives and meet customer needs, given that the current RIB rate structure appeared to yield little or no energy savings in F2016 and F2017.

2. Given the finding that larger consuming customers are more price responsive in the winter than in summer, consider exploring the value of a seasonal rate, with different pricing and consumption thresholds in the winter.

3. Consider the value of targeting small electricity consumers (e.g. those living in apartments) with existing or new DSM program offers, given their increased response to price changes in recent years.

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5.0 Conclusions

Although awareness of the RIB rate has remained relatively unchanged over the past five years at just under 50 percent among all residential customers, the survey analysis has shown that a greater proportion of small customers now feel that electricity prices are too high and the econometric analysis has indicated that they have become more responsive to price changes.

Overall, the RIB rate appears to have achieved its objective of encouraging conservation through the customer response to higher marginal prices. However, the effectiveness of the RIB rate in yielding electricity savings appears to have diminished over time.

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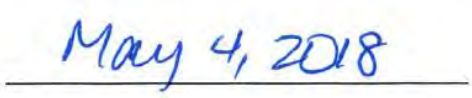
Evaluation Oversight Committee Signoff

BC Hydro's Evaluation Oversight Committee is made up of DSM stakeholders from various parts of the company and is mandated to ensure that BC Hydro's DSM evaluations are objective, unbiased and of sufficient quality.

The F20013-F2017 RIB evaluation meets the following criteria for approval by the Evaluation Oversight Committee:

1. The evaluation complied with the defined scope.
2. The evaluation methodology is appropriate given the available resources at the time of the evaluation.
3. The evaluation results are reasonable given the available data and resources at the time of the evaluation.

Serina Grahn
Evaluation Oversight Committee Chair



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Abbreviations and Glossary

BCUC: British Columbia Utilities Commission

CDD: Cooling Degree Days. A measurement to reflect the amount of energy required to cool a building derived from outdoor air temperature. Cooling degree days are defined relative to a base temperature (18°C).

CRI: Conservation Research Initiative – A pilot project started in November 2006 to investigate the capabilities of smart meters including critical peak pricing and load control components.

DSM: Demand Side Management

Evaluated Savings: Savings estimates reported after the energy efficiency activities have been implemented and an impact evaluation has been completed.

Experimental Design: Also known as a randomized controlled experiment where participants in the experiment are randomly assigned to either the treatment or control group to attempt to isolate the effects of the treatment itself from all other (unknown) sources of variation.

HDD: Heating Degree Days. A measurement to reflect the amount of energy required to heat a building derived from outdoor air temperature. Heating degree days are defined relative to a base temperature (18°C).

Natural Conservation: Refers to those efficiency improvements that would occur in the absence of any DSM activity. Natural conservation may be due to equipment efficiencies, behaviors, changes to codes and standards or simply reactions to rate increases.

OLS: Ordinary Least Squares - a method for estimating the unknown parameters in a linear regression model. This method minimizes the sum of squared vertical distances between the observed responses in the dataset and the responses predicted by the linear approximation.

Reported Savings: Savings estimates reported by a program or initiative implementer/administrator after an energy efficiency activity has been completed. Also called *claimed savings* or *tracking estimates.*

RIB: Residential Inclining Block

Quasi-experiment: In a quasi-experimental design, there is no random assignment to a treatment or control group. Treatment and comparison group members are matched on relevant characteristic(s).

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Appendix A: Results Summary

Evaluation Objective 1: Price Elasticity

Table A.1: Step 1 and Step 2 Price Elasticity Estimates

Round	Time Series Analyzed	Step 1 Elasticity	Step 2 Elasticity
1	F05-F12	Not statistically significant	-0.08 to -0.13***
2	F05-F15	Not statistically significant	Not analyzed
4	F05-F17	-0.14***	-0.08***

*** indicates the statistical significance at 95% confidence level or higher

Evaluation Objective 2: Conservation Impacts of the RIB Rate

Table A.2: RIB Rate Savings F2013-F2015

Fiscal Year	Step 1 Price Impact (GWh)	Step 2 Price Impact (GWh)	Natural Conservation (GWh)	RIB Structural Savings (GWh)
	A	B	C	(A + B - C)
Elasticity	**0.00**	**-0.08**	**-0.05**	**-**
F2013	-	49	24	23
F2014	-	16	13	3
F2015	-	74	62	13

Table A.3: RIB Rate Savings F2016-F2017

	Step 1 Price Impact (GWh)	Step 2 Price Impact (GWh)	Natural Conservation (GWh)				RIB Structural Savings (GWh)			
	A	B	C				(A + B- C)			
Elasticity	**-0.14**	**-0.08**	**-0.08**	**-0.09**	**-0.10**	**-0.14**	**-0.08**	**-0.09**	**-0.10**	**-0.14**
F2016	26	45	60	67	75	104	11	4	(3)	(33)
F2017	13	23	29	33	37	52	6	2	(2)	(16)

Table A.4: Reported and Evaluated RIB Rate Savings

	Energy Savings (GWh)		Peak Demand Savings (MW)	
Fiscal Year	Reported	Evaluated	Reported	Evaluated
F2013	42	23	9	5
F2014	19	3	4	1
F2015	59	13	12	3
F2016	29	0 to 11	6	0 to 2
F2017	8	0 to 6	2	0 to 1

Evaluation Objective 3: Differences in Price Elasticity by Customer Characteristics

Table A.5: Step 1 and Step 2 Price Elasticity by Customer Characteristics

Customer Segment	Step 1 Elasticity	Step 2 Elasticity
Region		
Lower Mainland	-0.22***	Not statistically significant
Vancouver Island	-0.18***	-0.12***
Southern Interior	Not statistically significant	Not statistically significant
North	-0.23***	Not statistically significant
Dwelling Type		
Single Family Dwelling	-0.04***	-0.08***
Row/Townhouse	-0.14***	-0.10***
Apartment	-0.26***	-0.07***
Mobile Home	-0.12***	-0.09***
Space Heating		
Electric	-0.11***	Not statistically significant
Non-Electric	-0.18***	-0.17***
Winter vs. Summer		
	Not statistically significant	Winter is more negative than summer by -0.05

*** indicates statistically significant at 95% confidence level

Appendix B: Evaluation Advisor Memos

May 9, 2018

To: BC Hydro

From: Rafael Friedmann
Evaluation Consultant
Oakland, California, USA

Re: Evaluation of the Residential Inclining Block Rate F2013-F2017

1. What is your assessment of the quality of the research design? If you identify any shortcomings, what is your assessment of their potential risk for the validity of the evaluation results?

   The research design and objectives make sense, but the ability to get actionable results was limited by two main factors: i) better understanding of how the RIB, the absolute energy bill, and other factors played into customers' actions; and ii) getting a solid counterfactual (the flat rate case).

2. What is your assessment of the quality of the input data? If you identify any shortcomings, what is your assessment of their potential risk for the validity of the evaluation results?

   The evaluation team did a great job at drawing from a variety of data sources to optimize the cost-effectiveness of the research. Input data for the most part was good. The core difficulty was getting enough data to overcome the relatively small "signal" and large amount of "noise".

3. What is your assessment of the quality of the analytical methods? If you identify any shortcomings, what is your assessment of their potential risk for the validity of the evaluation results?

   The analytical methods were sound. The focus on determining an elasticity of demand for both the RIB and the flat rate, and then estimating savings as the difference between these made sense a priori. But it appears that due to how small the elasticities were, that about ½ of the customers' surveyed didn't know they were on RIB or what it was, resulted in much lower "signal" compared to the "noise" of other factors. The ongoing increase in rates apparently had more of an effect than the RIB. A larger focus on understanding customers' reactions to both RIB and absolute increase in their rates and how these led or not to energy saving actions would have enabled a better understanding of the influence of these and how to proceed to improve rate design.

4. How does the methodology compare to common industry practice for evaluations of similar initiatives?

   Methodology for estimating elasticities is aligned with common industry practice. Similarly, with regards to estimating savings and customer understanding of rate structures. A broader and deeper use of qualitative methods would have possibly provided a better understanding of customers' key motivating factors to take energy saving actions. For example, what were the synergistic effects of increasing rates and the RIB? Would the RIB have a larger effect if more effort were put to educate customers on it and the benefits of small reductions in energy having large effects on bills? How would

customers react if their entire energy use were charged at the marginal rate they fell in the RIB (Mexico did this for a while)?

5. What are your suggestions for future evaluations of this DSM initiative?

   Future work should examine in more detail objective #4 – how well customers understand their rate structure and how changes to their energy use affect their bills, and whether these are material enough to effect increased conservation and energy efficiency actions by customers. Such research would provide more insight on what types of changes to the rate structure will be most effective at getting customers to modify their energy use (and potentially, at specific times of the day and year).

6. Do you have any other comments that you would like to make?

   This was a very difficult effort; very small “signal”, lots of “noise”. The evaluation team did a good job at drawing from a variety of data sources to develop elasticity and savings estimates. Findings offer elasticity results, but less on what to do in view of these, due to the uncertainty in these results and need for a deeper understanding of the reasons (i.e., customer motivators) behind the observed energy use changes.

Date: May 9, 2018

To: BC Hydro

From: Steven Braithwait, PhD
Vice President (retired), Christensen Associates Energy Consulting
Madison, Wisconsin

Re: Evaluation of the Residential Inclining Block Rate F2013-F2017, April 2018

1. What is your assessment of the quality of the research design? If you identify any shortcomings, what is your assessment of their potential risk for the validity of the evaluation results?

   The research design of the evaluation is of reasonably high quality for the approach chosen. That is, given that the target program involves a rate change (*i.e.*, from a flat rate to a residential inclining block rate, or RIB), the evaluators attempted to estimate price elasticities for customers' consumption on the two pricing blocks (Blocks 1 and 2). They then calculate RIB conservation impacts by applying the elasticities to the corresponding percentage changes in prices. One potential shortcoming of this design is that estimating price elasticities for a utility can be challenging due to typically small changes in prices, which also tend to follow a trend over time, leading to relatively few independent observations on price changes. Another potential shortcoming involves the element of the design that requires estimation of consumers' price elasticity for the flat rate that would otherwise have been in place. Uncertainties surrounding this estimated price elasticity and the block price elasticities results in a somewhat wide range of estimated RIB conservation impacts that vary substantially from year to year.

2. What is your assessment of the quality of the input data? If you identify any shortcomings, what is your assessment of their potential risk for the validity of the evaluation results?

   The quality of the input data is high. BCH has extensive time-series data on their customers' bi-monthly energy consumption, weather, geographical region and rates.

3. What is your assessment of the quality of the analytical methods? If you identify any shortcomings, what is your assessment of their potential risk for the validity of the evaluation results?

   The analytical methods used to estimate price elasticities for Block 1 and Block 2 consumption are competent. However, the methods used to calculate conservation impacts of RIB implementation are needlessly convoluted, leading to considerable uncertainty regarding the estimated impacts. The problems arise from the nature of the analytical approach, which assumes that the price changes to which the estimated elasticities are applied should be year-to-year changes in the individual block prices. This assumption in turn implies the need to estimate a price elasticity for the flat rate (which customers no longer experience) so that naturally-occurring price impacts may be subtracted from RIB impacts. Lacking the ability to estimate a price elasticity for a non-existing rate, the researchers make an arbitrary assumption that it is a blend of the Block 1 and 2 price elasticities, and calculate a range of conservation impacts under alternative assumptions regarding the flat rate elasticities.

As I have suggested in previous comments, a more appropriate evaluation approach would be to calculate the relevant price changes as the percentage changes in the two block prices *relative to the flat rate* that would otherwise have applied. That is, an evaluation of any program or rate involves a comparison to a counter-factual reference case of what would have occurred had the program or rate not been offered to customers. In the case of RIB, the reference case is that customers would have faced the flat rate rather than the RIB rates. Thus, the relevant price change is the difference between the relevant RIB rate and the flat rate. As a result, Block 1 customers experience prices that are approximately 15 percent lower than they would have been under the flat rate, while Block 2 customers see prices that are 25 percent higher. Under this approach to calculating RIB impacts there would be no need to estimate a separate elasticity for the non-existing flat rate; the naturally-occurring price response would be accounted for in the relative price changes.

4. How does the methodology compare to common industry practice for evaluations of similar initiatives?

   The methodology for estimating price elasticities is comparable to common industry practice for applications such as load forecasting. However, for evaluating the impacts of the RIB rate change, other methodologies, such as those used for estimating load impacts of demand response (DR) programs and dynamic pricing are more common. These are generally intervention models in which an impact variable is used to directly estimate the effect of a rate or DR program. The binary variable takes on the value *zero* in pre-RIB billing periods and *one* following RIB implementation (the variable may be interacted with time to allow time-varying impacts), such that the coefficient on the variable represents the program impact. Such variables could be included in separate regressions using billing data for Block 1 and Block 2 consumption.

5. What are your suggestions for future evaluations of this DSM initiative?

   In future analyses I would suggest exploring two alternative research paths. One would explore intervention models of the type described above (and in the report) to estimate RIB impacts directly. The other would undertake additional analyses of price elasticities using alternative methods, particularly using dynamic models that account for possible lagged, or delayed responses to price changes. Finally, I recommend a review of the assumptions regarding the price changes that Block 1 and Block 2 customers experience compared to the counter-factual flat rate.

6. Do you have any other comments that you would like to make?

   I would suggest that future evaluations also explore the relationship between RIB impacts on residential energy consumption and the impacts of BC Hydro's DSM conservation programs. Some initial attempts along these lines were attempted in the current evaluation and are described in the report. No statistically significant results of expected signs were found, suggesting opportunities for further exploration into data on DSM expenditures and reported savings, and on methods used in the RIB evaluation to incorporate those data.

Appendix C: Approach Details

C.1. Econometric Modeling

Price elasticity analysis started with the three electricity consumption models and their basic functional forms as shown in Equations 1, 2 and 3 in Section 2.3.1. In setting up consumption models, the following factors that are significant drivers for electricity consumption at the aggregate level were considered:

Electricity Price: Economic theory holds that price impacts consumption. Historical electricity prices for residential customers were obtained from BC Hydro Tariff documents.

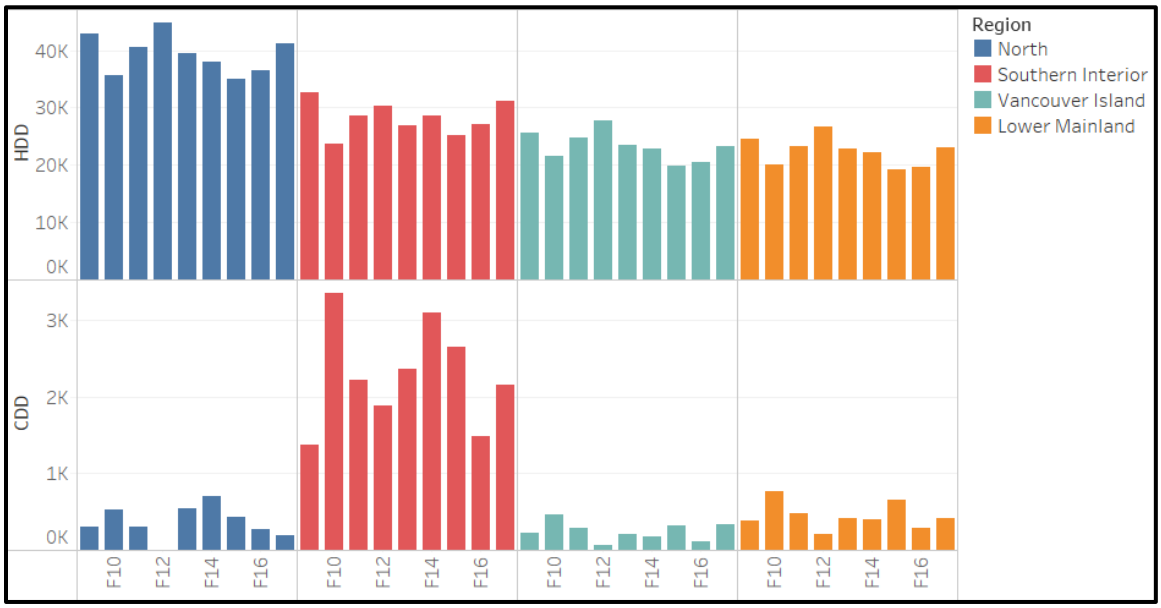
Adjusting Historical Prices using the BC CPI: Table C.1 presents a schedule of the historical prices for the Step 1, Step 2 and flat rate. The table also shows the year over year percentage change in the real price by adjusting the nominal prices for inflation, based on the consumer price index ("CPI") shown in the far-right column.

Table C.1: Historical Prices vs. Consumer Price Index

	Nominal Price (cents/kWh)			Percentage Change in Real Price from Previous Year			
Fiscal Year	Step 1	Step 2	Flat Rate (1151)	Step 1	Step 2	Flat Rate	Consumer Price Index (base year of 2002)
F2008			6.14	-	-	-	110.3
F2009	5.46	7.21	6.29	-12.8%	15.1%	0.4%	112.5
F2010	5.91	8.27	6.84	8.2%	14.7%	8.7%	112.5
F2011	6.27	8.78	7.26	4.2%	4.3%	4.3%	114.5
F2012	6.67	9.62	7.84	4.1%	7.2%	5.7%	117.0
F2013	6.8	10.19	8.15	1.1%	5.0%	3.1%	118.0
F2014	6.9	10.34	8.27	1.6%	1.6%	1.6%	117.8
F2015	7.52	11.27	9.01	8.3%	8.3%	8.2%	118.6
F2016	7.97	11.95	9.55	4.8%	4.9%	4.8%	119.9
F2017	8.29	12.43	9.93	2.3%	2.3%	2.3%	121.9

Weather: Weather affects electricity consumption through space heating, water heating and air conditioning loads. Heating Degree Days (HDD) and Cooling Degree Days (CDD) representing bi-monthly temperature variations were used to control for weather impacts on electricity consumption. Figure C.1.1 below shows the values of HDD and CDD for the four BC regions over time.

Figure C.1.1. Regional HDD and CDD from F2009 to F2017



Seasonality: Seasonality impacts electricity use through changes to the hours of daylight, seasonal holidays and other general changes in the mix of electricity end-uses based on a given time of year. Six bimonthly billing periods were used to control for seasonal impacts beyond those associated with weather.

Space heating fuel: Space heating is a large end-use of energy for BC Hydro's residential customers. Space heating in British Columbia most commonly uses natural gas or electricity followed by wood and propane. Primary space heating fuel type is estimated at the account level from the BC Hydro billing system. For the purpose of this analysis, primary space heating fuel was defined as either electric or non-electric.

Dwelling type: Dwelling type impacts electricity consumption through factors such as overall heating demand, number of appliances, number of occupants, and construction material. Dwelling type is maintained in the BC billing system using the following classifications: single family detached, row house, apartment, and mobile home.

Note that "Other" dwelling types included in the 2014 evaluation had an unusually high consumption level compared to the other categories of dwellings and showed an irregular consumption pattern in previous years. As a result, this category of residential homes (about 3% of total residential accounts) was not included in the current evaluation.

DSM Expenditures: BC Hydro's expenditures on DSM programs and sector enabling activities impacts electricity consumption by providing information and incentives for electricity conservation as well as development of codes and standards. Bi-monthly expenditures from F2005 to F2017 were obtained and allocated across the various account sub-groups (region, dwelling type, heating type) based on the number of accounts in each group. The impact of expenditures on DSM by agencies other than BC Hydro were not included because they either target different customer groups or were expected to be too small to be measured using the aggregate analysis of demand models adopted in this evaluation.

DSM Savings: Energy savings from BC Hydro's DSM programs, and federal or provincial government codes and standards have an impact on electricity consumption. Energy savings from F2005 to F2017 were collected from BC Hydro's record of DSM savings in the residential sector. Such saving impacts can be incorporated in the econometric models to test their influence on price elasticity estimate.

Economic Factors: Economic theory holds that income impacts consumption. Annual personal real disposable income in British Columbia was obtained through BC Stats. Adjustments for the impact of inflation were done using the monthly Consumer Price Index (CPI) from Statistics Canada.

Region: The BC Hydro service territory is divided into four geographic regions: Lower Mainland, Vancouver Island, Southern Interior and North. Region impacts electricity consumption through differences in demographics and lifestyle of their residents.

Interactions between variables: Adding interaction terms to the regression model may help to explain the relationships between some of the variables. For example, the relationship between weather and heating fuel type are expected to have a strong influence on overall consumption since households with electric heat would have higher consumption in colder weather compared to households with non-electric heat.

Correction Term: The bias correction term is based on the construction of a log odd regression whose dependent variable is Y = ln[S / (1-S)], where S = large user share of total accounts. Since the small user share will be (1-S), the correction term for the small user regression is based on the same log odd regression. The coefficient estimate on the correction term for the Step 2 regression is expected to be negative, based on an assumption that if a random factor causes more accounts to be in the large user group, the same factor also tends to enlarge the per account consumption. Conversely, the correction term's coefficient estimate for the small user (Step 1) regression is expected to be positive. The assumption is that if a random factor causes more accounts to be in the small user group, the same factor also tends to decrease the per account consumption.

Testing the models: Each of the econometric models was assessed for validity through:

- Statistics of the adjusted R-squared for overall regression model validity;
- Expected signs (or values) of coefficients for individual independent variables and their statistical significance;

C.2. Customer Surveys

Detailed information about the 2012 and 2017 RIB survey methodologies are presented in Section 2.3.4 of the report.

This section presents additional information in regards to the Residential End-Use Studies that were leveraged in this evaluation, an exploration of the 2017 RIB survey sample, and a description of the statistical tests used in the analysis of the RIB survey data.

C.2.1 Residential End-Use Studies

Findings from BC Hydro's 2014 and 2017 Residential End-Use Studies were leveraged – due to their very large sample sizes and representativeness – to serve as population proxies in confirming the reliability of the 2017 RIB survey sample.

As was done for the 2012 RIB survey sample in concert with the 2012 end-use study, the 2017 RIB survey sample and the distribution of customer contact demographics, household characteristics and electricity consumption were compared – and as shown in the next section, validated – to the distributions of RIB customers ascertained from the 2014 and 2017 end-use studies.

Each of the 2014 and 2017 end-use studies featured a self-administered data collection approach, and afforded respondents to complete the survey in either in a print format or online.

The 2014 study was comprised of 7,318 customer respondents on the RIB rate while the 2017 study was comprised of 6,929 customer respondents on the RIB rate.

C.2.2 2017 RIB Survey Sample Profile

This section details the distribution of the 2017 survey sample – after statistical weighting – on a number of different fronts, such as customer demographics and household characteristics, and compares the distributions to those of the population of residential customers. In doing so, a comprehensive profile of customer households is presented, and the sample is certified as being very representative of the population from which it was drawn.

Population and 2017 Survey Sample Profile of RIB Customers

Table C.2. details the population distribution of BC Hydro's 1.7 million RIB qualified customers on four known population parameters in the corporation's customer account billing system – region, dwelling type, age of primary account holder and Step 2 electricity consumption status – and the 2017 survey sample distribution of customers after statistical weighting.

The single largest segment of residential customers in 2017 – 59 percent – resided in the Lower Mainland, followed by Vancouver Island, the Southern Interior and the North. The distribution of dwelling types followed much of the same pattern in that 57 percent of customers lived in single detached houses and duplexes while most others lived in apartments and condominiums rather than in row houses and townhouses, mobile homes and 'other' types of dwellings.

Table C.2: Population and 2017 Survey Sample Profile of RIB Customers

	2017 Population*	2017 Survey Sample
Region		
Lower Mainland	59%	59%
Vancouver Island	21%	21%
Southern Interior	12%	12%
North	8%	8%
Total	100%	100%
Dwelling Type		
Single detached house/duplex	57%	57%
Row house/townhouse	9%	10%
Apartment/Condominium	28%	28%
Mobile home/other	5%	5%
Total	100%	100%
Age of Primary Account Holder		
18-24	2%	1%
25-34	11%	12%
35-44	17%	16%
45-54	21%	21%
55-64	23%	23%
65+	27%	27%
Total	100%	100%
Step 2 Consumption Status in F2017		
Never into Step 2 (0 months)	30%	31%
Sometimes into Step 2 (1-11 months)	48%	47%
Always into Step 2 (12 months)	22%	22%
Total	100%	100%

Column totals may not total 100% due to the rounding of values.
* As per BC Hydro's customer account billing system for region, dwelling type, age of primary account holder and Step 2 electricity consumption status.

As per the overall population, 71 percent of primary account holders in the 2017 survey sample were 45 years old or older, including some 50 percent who were at least 55 years old.

The distribution of customers in the 2017 survey sample also very closely followed the overall population in terms of the number of times households incurred Step 2 electricity consumption in F2017. Although most customers are billed on a bi-monthly basis and the Step 2 threshold is set at 1,350 kWh, this statistic is based on calendarized monthly consumption with the Step 2 threshold at 675 kWh.

A total of 31 percent of customers in the sample never (0 months) incurred Step 2 electricity consumption in the twelve months of F2017, 47 percent of customers sometimes (1-11 months) incurred Step 2 electricity consumption and 22 percent always (12 months) did so. This observation – underscoring the representativeness of the survey sample – is important due to the fact that customer awareness levels and opinions toward the RIB rate have proven to be highly correlated to exposure to Step 2 and overall electricity consumption.

Housing Profile of RIB Customers

As BC Hydro's customer account billing system does not include housing and demographic information beyond region, dwelling type and age, its 2017 Residential End-Use Study was leveraged to serve as a proxy for further sample comparisons to the population due to its very large sample size and representativeness. At the time of this evaluation, however, analysis of the space heating and water heating fuels in the 2017 end-use study had not been completed and, for that reason, the 2014 end-use study was instead leveraged for these two items.

Table C.3: Housing Profile of the Population and 2017 Survey Sample of RIB Customers

	2017 Population*	2017 Survey Sample
Main Space Heating Fuel		
Electricity	43%	45%
Non-Electric	57%	55%
Total	100%	100%
Main Water Heating Fuel		
Electricity	37%	35%
Non-Electric	41%	41%
No hot water tank (central)	23%	24%
Total	100%	100%
Floor Area (square feet)		
<500	1%	1%
500-1,000	24%	23%
1,001-1,500	21%	22%
1,501-2,000	17%	17%
2,001-2,500	16%	15%
2,501-3,000	10%	11%
Over 3,000	11%	10%
Average	1,869	1,857
Total	100%	100%
Year Home Built		
Before 1950	7%	8%
1950-1975	23%	24%
1976-1985	17%	19%
1986-1995	19%	16%
1996-2005	14%	15%
2006-2015	18%	17%
2016-2017	1%	1%
Total	100%	100%

Column totals may not total 100% due to the rounding of values.

* As per the distribution of RIB qualified tariff 1101 records in BC Hydro's 2017 Residential End-Use Study. Main space heating fuel and main water heating fuel as per the distribution of RIB qualified tariff 1101 records in BC Hydro's 2014 Residential End-Use Study.

Very similar to the population, 45 percent of households in the 2017 survey sample relied primarily on electricity for their space heating. A total of 35 percent of households in the 2017 survey sample relied on electricity for their home's water heating needs. It follows that 41 percent of customers relied on non-electric fuels for their hot water heating while 24 percent of customers – most of them in apartments and condominiums – received their hot water from their building's central system. The profile of survey sample in terms of dwelling floor space and vintage also very closely followed that of the overall population.

Demographic Profile of RIB Customers

The demographic composition of the survey sample was very representative of the population in terms of primary account holders being generally split by gender and by the distribution of their age (as previously shown in Table C.2.). Close to four in ten account holders had earned university degrees while the balance of others were most likely to have attended university, college, vocational or technical school.

Table C.4: Demographic Profile of the Population and 2017 Survey Sample of RIB Customers

	2017 Population*	2017 Survey Sample
Gender of Primary Account Holder		
Male	50%	48%
Female	50%	52%
Total	100%	100%
Education of Primary Account Holder		
Less than grade 12	7%	6%
High school diploma	13%	13%
Some college/vocational/technical school	18%	17%
College/vocational/technical school graduate	21%	20%
Some university	7%	7%
University/Graduate Degree	34%	37%
Total	100%	100%
Home Ownership		
Own/Co-op	80%	81%
Rent	20%	19%
Total	100%	100%
Number of Household Occupants		
1	23%	23%
2	41%	40%
3	14%	13%
4 +	22%	24%
Average number of occupants	2.5	2.6
Total	100%	100%
Household Composition		
Has children 0-5	11%	10%
Has children 6-12	12%	13%
Has young adults 13-24	19%	20%
Has adults 25-64	76%	77%
Has adults 65 +	33%	33%
Total	100%	100%

Column totals may not total 100% due to the rounding of values.
* As per the distribution of RIB qualified tariff 1101 records in BC Hydro's 2017 Residential End-Use Study.

Similar to as seen in the 2017 end-use study, a total of 81 percent of residential customers in the 2017 survey sample owned their homes.

The profile of survey respondents in terms of their household composition and household income closely followed that of all BC Hydro residential customers on the RIB rate. Households in the survey sample were comprised of an average of 2.6 people and approximately six in ten had annual earnings of $60,000 or more.

Table C.5: Demographic Profile of the Population and 2017 Survey Sample of RIB Customers (Continued)

	2017 Population*	2017 Survey Sample
Household Income		
Less than $20,000	8%	7%
$20,000 < $40,000	19%	18%
$40,000 < $60,000	17%	18%
$60,000 < $80,000	14%	14%
$80,000 < $100,000	14%	13%
$100,000 < $120,000	11%	11%
$120,000 +	19%	20%
Total	100%	100%
Low Income Status		
Yes, 'low income' household	11%	11%
No	89%	89%
Total	100%	100%

Column totals may not total 100% due to the rounding of values.
* As per the distribution of RIB qualified tariff 1101 records in BC Hydro's 2017 Residential End-Use Study.

The overall incidence of BC Hydro's RIB qualified customers in 2017 that could be classified as 'low income' as defined by Statistics Canada was estimated to have been 11 percent[25].

C.2.3 Statistical Tests

Analysis of the 2017 RIB survey sample primarily relied on frequency distributions and cross tabulations of responses. Statistical testing of differences in proportions in survey responses between groups was conducted by z-tests at the 95 percent level of confidence.

Analysis of household electricity consumption among groups of households in the survey sample was analyzed via means procedures and statistical testing of differences in means was conducted by the analysis of variance procedure at the 95 percent level of confidence.

[25] The low income cut-off (LICO) rate as defined by Statistics Canada is the percentage of families or households which fall below a low income threshold – that being, an income level whereby a family spends a larger share of its total income on the necessities of food, shelter and clothing than does an average family in an appropriate comparison group (the lower a household's income, a greater percentage of the total is tied to the necessities of living). Three variables together identify low income households of interest: annual household income, number of household occupants, and population of the household's census metropolitan area (CMA). Households with annual earnings less than the Low Income Cut-Off (LICO) for their household size and CMA population are considered low income.

Appendix D: Results Detail

D.1. Econometric Modeling Results

The results of Step 1 and Step 2 price elasticity from three econometric models are provided below. The data applied to these econometric models covered the period from April 2004 to December 2016 (F2005 through F2017).

Step 1 Price Elasticity

Model 1

Basic functional form:

$$\ln(Consumption) = \alpha + \beta \cdot Heat + \gamma \cdot Dwelling + \delta \cdot BillingPeriod + \omega 1 \cdot CDD + \omega 2 \cdot HDD$$
$$+ \xi \cdot Region + \varepsilon \cdot ln\,(Price) + \sigma \cdot ln\,(Disposable\_Income) + \varphi \cdot C + \mu$$

With the confidence level set at 95 percent or higher (or with the *Pr* > |*t*| column in the table below showing a value equal to or smaller than 0.05), the model 1 results indicate that the statistically significant (different than zero) coefficients are those associated with billing period, heating fuel type, region, dwelling type and price. Income and weather are not significant drivers for Step 1 electricity consumption as Step 1 consumption varies little with the weather or income variables.

Step 1 price elasticity is estimated at -0.14.

Root MSE	0.07357	*R-Square*	0.8613
Dependent Mean	6.64328	*Adj R-Sq*	0.8606
Coeff Var	1.10744		

Parameter Estimates

Variable	*Label*	*DF*	*Parameter Estimate*	*Standard Error*	*t Value*	*Pr > |t|*
Intercept	Intercept	1	6.80449	0.06862	99.17	<.0001
BP_1	Billing Period Apr-May	1	-0.09060	0.00712	-12.72	<.0001
BP_2	Billing Period Jun-Jul	1	-0.17511	0.00974	-17.98	<.0001
BP_3	Billing Period Aug-Sep	1	-0.13496	0.00910	-14.83	<.0001
BP_4	Billing Period Oct-Nov	1	0.02973	0.00531	5.60	<.0001
BP_5	Billing Period Dec-Jan	1	0.09209	0.00665	13.86	<.0001
D_heat_elec	Dummy Variable: Electric Heating Home	1	0.08870	0.00300	29.53	<.0001
D_Reg_SI	Dummy Variable of Region: Southern Interior	1	-0.04914	0.00372	-13.22	<.0001
D_Reg_N	Dummy Variable of Region: North	1	-0.02525	0.00370	-6.83	<.0001
D_APT	Dummy Variable of Dwell Type: Apartment	1	-0.75585	0.01928	-39.21	<.0001
D_ROW	Dummy Variable of Dwell Type: Row House	1	-0.29618	0.01240	-23.89	<.0001
D_MOB	Dummy Variable of Dwell Type: Mobile Home	1	-0.10879	0.00623	-17.47	<.0001
ln_P1	Natural Logarithm of Step 1 Price	1	-0.14448	0.02201	-6.56	<.0001
C_small	correction term: small customers	1	0.18021	0.01051	17.15	<.0001

Model 2

Basic functional form:

$$\ln(Consumption) = \alpha + \beta \cdot Heat + \gamma \cdot Dwelling + \delta \cdot BillingPeriod + \omega 1 \cdot CDD + \omega 2 \cdot HDD$$
$$+ \text{ʒ} \cdot Region + \theta \cdot \ln\left(DSM_{Expenditure}\right) + \varepsilon \cdot \ln(Price)$$
$$+ \sigma \cdot \ln(Disposable\_Income) + \varphi \cdot C + \mu$$

This model tests whether adding DSM expenditure will affect the estimate of price elasticity or the coefficients of other variables.

Step 1 price elasticity is estimated at -0.14 in model 2 where BC Hydro's DSM expenditure is added in the equation. This Step 1 price elasticity result is close to the step 1 price elasticity estimate from Model 1. The results from model 2 show that DSM expenditure is not a statistically significant variable with its coefficient associated with a wrong sign and a large p-value. Adding DSM expenditure in the model only affects the coefficient estimates in a very minor way as compared to the results from model 1. These results suggest omitting DSM expenditures from the model used to estimate price elasticity does not introduce meaningful levels of uncertainty or error.

Root MSE	0.07356	*R-Square*	0.8614
Dependent Mean	6.64328	*Adj R-Sq*	0.8606
Coeff Var	1.10734		

Parameter Estimates

Variable	*Label*	*DF*	*Parameter Estimate*	*Standard Error*	*t Value*	*Pr > |t|*
Intercept	Intercept	1	6.82761	0.07129	95.77	<.0001
BP_1	Billing Period Apr-May	1	-0.09056	0.00712	-12.72	<.0001
BP_2	Billing Period Jun-Jul	1	-0.17525	0.00974	-17.99	<.0001
BP_3	Billing Period Aug-Sep	1	-0.13506	0.00910	-14.84	<.0001
BP_4	Billing Period Oct-Nov	1	0.02967	0.00531	5.58	<.0001
BP_5	Billing Period Dec-Jan	1	0.09203	0.00665	13.85	<.0001
D_heat_elec	Dummy Variable: Electric Heating Home	1	0.08870	0.00300	29.54	<.0001
D_Reg_SI	Dummy Variable of Region: Southern Interior	1	-0.04914	0.00372	-13.23	<.0001
D_Reg_N	Dummy Variable of Region: North	1	-0.02525	0.00369	-6.83	<.0001
D_APT	Dummy Variable of Dwell Tyep: Appartment Building	1	-0.75585	0.01928	-39.21	<.0001
D_ROW	Dummy Variable of Dwell Tyep: Row House	1	-0.29618	0.01240	-23.89	<.0001
D_MOB	Dummy Variable of Dwell Tyep: Mobile Home	1	-0.10879	0.00623	-17.47	<.0001
ln_P1	Natural Logrithm of Step 1 Price	1	-0.13562	0.02323	-5.84	<.0001
Ln_DSM_Acct_Bimonth_MovAvg6	12-month moving average of DSM expenditures	1	0.00515	0.00431	1.20	0.2321
C_small	correction term: small customers	1	0.18021	0.01051	17.15	<.0001

Model 3

Basic functional form:

$$\ln(Consumption + DSM\ Savings) = \alpha + \beta \cdot Heat + \gamma \cdot Dwelling + \delta \cdot BillingPeriod + \omega 1 \cdot CDD + \omega 2 \cdot HDD + \mathfrak{z} \cdot Region + \varepsilon \cdot \ln(Price) + \sigma \ln(Disposable_{Income}) + \varphi \cdot C + \mu$$

When DSM savings were added to Step 1 electricity consumption, a statistically significant estimate of Step 1 price elasticity of -0.17 was found. This estimate is related to electricity consumption in the absence of conservation effects, therefore the price elasticity estimate in this way encompasses conservation effects generated by other DSM initiatives. In light of the conflicting result from model 2, which indicated that DSM expenditure was not a valid variable and did not affect the Step 1 elasticity estimate, it is difficult to determine how DSM initiatives affect the Step 1 elasticity estimate. The elasticity estimate from model 3 contains some DSM conservation impact in addition to price impact and is deemed not to be a true estimate of the Step 1 price elasticity.

Root MSE	0.07422	R-Square	0.8502
Dependent Mean	6.67838	Adj R-Sq	0.8494
Coeff Var	1.11132		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	6.72860	0.06922	97.20	<.0001
BP_1	Billing Period Apr-May	1	-0.05312	0.00718	-7.39	<.0001
BP_2	Billing Period Jun-Jul	1	-0.16727	0.00983	-17.02	<.0001
BP_3	Billing Period Aug-Sep	1	-0.13079	0.00918	-14.24	<.0001
BP_4	Billing Period Oct-Nov	1	0.02991	0.00536	5.58	<.0001
BP_5	Billing Period Dec-Jan	1	0.09367	0.00670	13.97	<.0001
D_heat_elec	Dummy Variable: Electric Heating Home	1	0.08502	0.00303	28.06	<.0001
D_Reg_SI	Dummy Variable of Region: Southern Interior	1	-0.04761	0.00375	-12.70	<.0001
D_Reg_N	Dummy Variable of Region: North	1	-0.02449	0.00373	-6.57	<.0001
D_APT	Dummy Variable of Dwell Type: Apartment Building	1	-0.72714	0.01945	-37.39	<.0001
D_ROW	Dummy Variable of Dwell Type: Row House	1	-0.28540	0.01251	-22.82	<.0001
D_MOB	Dummy Variable of Dwell Type: Mobile Home	1	-0.10497	0.00628	-16.71	<.0001
ln_P1	Natural Logarithm of Step 1 Price	1	-0.17351	0.02221	-7.81	<.0001
C_small	correction term: small customers	1	0.17327	0.01060	16.35	<.0001

Step 2 Price Elasticity

Model 1

Basic functional form:

$$\ln(Consumption) = \alpha + \beta \cdot Heat + \gamma \cdot Dwelling + \delta \cdot BillingPeriod + \omega 1 \cdot CDD + \omega 2 \cdot HDD$$
$$+ \xi \cdot Region + \varepsilon \cdot ln\,(Price) + \sigma \cdot ln\,(Disposable\_Income) + \varphi \cdot C + \mu$$

Step 2 price elasticity is estimated at -0.08.

Root MSE	0.11614	R-Square	0.7743
Dependent Mean	7.75960	Adj R-Sq	0.7729
Coeff Var	1.49679		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	6.33105	0.60970	10.38	<.0001
BP_1	Billing Period Apr-May	1	-0.17791	0.00832	-21.37	<.0001
BP_2	Billing Period Jun-Jul	1	-0.26376	0.00840	-31.41	<.0001
BP_3	Billing Period Aug-Sep	1	-0.25692	0.00837	-30.69	<.0001
BP_4	Billing Period Oct-Nov	1	-0.06819	0.00854	-7.98	<.0001
BP_5	Billing Period Dec-Jan	1	0.11526	0.00839	13.74	<.0001
D_heat_elec	Dummy Variable: Electric Heating Home	1	0.17665	0.00496	35.64	<.0001
D_Reg_SI	Dummy Variable of Region: Southern Interior	1	0.02087	0.00581	3.59	0.0003
D_Reg_N	Dummy Variable of Region: North	1	0.01811	0.00583	3.11	0.0019
D_APT	Dummy Variable of Dwell Type: Apartment Building	1	-0.33510	0.00671	-49.97	<.0001
D_ROW	Dummy Variable of Dwell Type: Row House	1	-0.28197	0.00671	-42.05	<.0001
D_MOB	Dummy Variable of Dwell Type: Mobile Home	1	-0.10968	0.00671	-16.36	<.0001
HDD	HDD	1	-0.00007054	0.00001637	-4.31	<.0001
D_ELEC_HDD	Interaction Term of Electric Heating Home and HDD	1	0.00010742	0.00002130	5.04	<.0001
ln_income	Natural Logarithm of Disposable Income	1	0.13785	0.05459	2.53	0.0116
ln_P2	Natural Logarithm of Step 2 Price	1	-0.08151	0.02169	-3.76	0.0002
C_large	correction term: large customers	1	-0.20262	0.01881	-10.77	<.0001

Model 2

Basic functional form:

$$\ln(Consumption) = \alpha + \beta \cdot Heat + \gamma \cdot Premise + \delta \cdot BillingPeriod + \omega 1 \cdot CDD + \omega 2 \cdot HDD$$
$$+ \xi \cdot Region + \theta \cdot \ln\left(DSM_{Expenditure}\right) + \varepsilon \cdot \ln(Price)$$
$$+ \sigma \cdot \ln(Disposable_{Income}) + \varphi \cdot C + \mu$$

DSM expenditures were included in Model 2, and resulted in a Step 2 price elasticity estimate of -0.10. However, the coefficient for DSM expenditures had a positive sign which indicated that increasing DSM expenditures added to electricity consumption. This is counter-intuitive and may be due to the reduction in BC Hydro's DSM expenditures in recent years that correspond to the general trend of the reduction in Step 2 price response. The positive coefficient for DSM expenditures affects the coefficients of other variables, meaning the Step 2 price elasticity from model 2 is not considered to be a true estimate of Step 2 price elasticity.

Root MSE	0. 11593	R-Square	0. 7753
Dependent Mean	7. 75960	Adj R-Sq	0. 7737
Coeff Var	1. 49406		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	6.11178	0.59563	10.26	<.0001
BP_1	Billing Period Apr-May	1	-0.27106	0.01196	-22.66	<.0001
BP_2	Billing Period Jun-Jul	1	-0.44805	0.01906	-23.50	<.0001
BP_3	Billing Period Aug-Sep	1	-0.41811	0.01714	-24.39	<.0001
BP_4	Billing Period Oct-Nov	1	-0.06827	0.00833	-8.20	<.0001
BP_5	Billing Period Dec-Jan	1	0.17350	0.00979	17.71	<.0001
D_heat_elec	Dummy Variable: Electric Heating Home	1	0.17665	0.00483	36.56	<.0001
D_Reg_SI	Dummy Variable of Region: Southern Interior	1	0.00989	0.00575	1.72	0.0857
D_Reg_N	Dummy Variable of Region: North	1	0.02514	0.00572	4.39	<.0001
D_APT	Dummy Variable of Dwell Type: Apartment Building	1	-0.78249	0.04197	-18.64	<.0001
D_ROW	Dummy Variable of Dwell Type: Row House	1	-0.47079	0.01868	-25.21	<.0001
D_MOB	Dummy Variable of Dwell Type: Mobile Home	1	-0.16621	0.00838	-19.84	<.0001
HDD	HDD	1	-0.00006274	0.00001613	-3.89	0.0001
D_ELEC_HDD1	Interaction Term of Electric Heating Home and HDD	1	0.00010742	0.00002077	5.17	<.0001
ln_income	Natural Logarithm of Disposable Income	1	0.14455	0.05326	2.71	0.0067
ln_P2	Natural Logarithm of Step 2 Price	1	-0.09919	0.02185	-4.54	<.0001
Ln_DSM_Acct_Bimonth_MovAvg6	Natural Logarithm of Bimonthly DSM expenditure of 6-period Moving Average	1	0.02303	0.00721	3.19	0.0014
C_large	correction term: large customers	1	-0.20265	0.01878	-10.79	<.0001

Model 3

Basic functional form:

$$\ln(Consumption + DSM\ Savings) = \alpha + \beta \cdot Heat + \gamma \cdot Dwelling + \delta \cdot BillingPeriod + \omega 1 \cdot CDD + \omega 2 \cdot HDD + \text{ʒ} \cdot Region + \varepsilon \cdot \ln(Price) + \sigma \ln(Disposable_{Income}) + \varphi \cdot C + \mu$$

When DSM savings were added to Step 2 electricity consumption, a statistically significant estimate of Step 2 price elasticity of -0.08 was found. This estimate is close to the result from Model 1, which indicates that the inclusion of DSM savings in the model had little impact on the Step 2 price elasticity estimate. This may be attributed to relatively small changes in DSM savings as compared to Step 2 consumption.

Root MSE	0.11561	R-Square	0.7721
Dependent Mean	7.77140	Adj R-Sq	0.7707
Coeff Var	1.48764		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	6.61386	0.59272	11.16	<.0001
BP_1	Billing Period Apr-May	1	-0.25987	0.01192	-21.80	<.0001
BP_2	Billing Period Jun-Jul	1	-0.44760	0.01900	-23.55	<.0001
BP_3	Billing Period Aug-Sep	1	-0.41860	0.01709	-24.50	<.0001
BP_4	Billing Period Oct-Nov	1	-0.06839	0.00830	-8.24	<.0001
BP_5	Billing Period Dec-Jan	1	0.17383	0.00977	17.80	<.0001
D_heat_elec	Dummy Variable: Electric Heating Home	1	0.17500	0.00482	36.32	<.0001
D_Reg_SI	Dummy Variable of Region: Southern Interior	1	0.00986	0.00574	1.72	0.0857
D_Reg_N	Dummy Variable of Region: North	1	0.02530	0.00571	4.43	<.0001
D_APT	Dummy Variable of Dwell Type: Apartment Building	1	-0.77869	0.04185	-18.61	<.0001
D_ROW	Dummy Variable of Dwell Type: Row House	1	-0.46767	0.01862	-25.11	<.0001
D_MOB	Dummy Variable of Dwell Type: Mobile Home	1	-0.16519	0.00835	-19.78	<.0001
HDD	HDD	1	-0.00006929	0.00001591	-4.36	<.0001
D_ELEC_HDD1	Interaction Term of Electric Heating Home and HDD	1	0.00010447	0.00002071	5.05	<.0001
ln_income	Natural Logrithm of Disposable Income	1	0.10323	0.05307	1.95	0.0519
ln_P2	Natural Logrithm of Step 2 Price	1	-0.07646	0.02108	-3.63	0.0003
C_large	correction term: large customers	1	-0.20251	0.01872	-10.82	<.0001

Analysis of Price Elasticity in New Westminster

The analysis of price elasticity of about 32,000 customers in New Westminster was conducted to estimate the flat rate elasticity as a proxy for BC Hydro's flat rate elasticity. The analysis covered the period from 2005 to 2016. The elasticity analysis was built on an average bi-monthly consumption model which incorporated customer data and information available to BC Hydro.

The specific model is as follows:

$$\ln(Consumption) = \alpha + \beta \cdot HeatingCode + \gamma \cdot Premise + \delta \cdot BillingPeriod + \omega 1 \cdot CDD + \omega 2 \cdot HDD + \varepsilon \cdot ln\,(Price) + \sigma \cdot ln\,(Income) + \mu$$

where

ln() denotes natural logarithm;

Consumption: is the average bi-monthly consumption per account in kWh;

HeatingCode: is a binary indicator (dummy variable) whose value is one to indicate the presence or zero to indicate absence of electricity as the primary space heating fuel;

Premise: represents single detached home, high-rise building, Multiple Apartment Block, and condominium;

BillingPeriod: contains six bi-monthly billing periods which are represented by BP_1, BP_2, … and BP_5 in the model output (the default period is BP_6);

CDD and HDD: represent cooling and heating degree days, respectively, which are used to represent weather impacts;

Price: electricity price (CPI-adjusted);

Income: personal disposable income (CPI-adjusted);

μ is the error term.

The modelling results as shown below indicate that price, income and billing period 5 were not statistically significant variables in the model.

Root MSE	0.19857	R-Square	0.9209
Dependent Mean	6.70386	Adj R-Sq	0.9189
Coeff Var	2.96205		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	9.92135	6.16729	1.61	0.1083
Ln_Price	Natural log of Electricity price adjusted by CPI	1	-0.04068	0.11153	-0.36	0.7154
Ln_income	Natural log of personal real income	1	-0.30442	0.56294	-0.54	0.5889
BP_1	Billing Period Apr-May	1	0.22477	0.06090	3.69	0.0002
BP_2	Billing Period Jun-Jul	1	0.37166	0.11746	3.16	0.0016
BP_3	Billing Period Aug-Sep	1	0.33562	0.11527	2.91	0.0038
BP_4	Billing Period Oct-Nov	1	0.11727	0.03729	3.14	0.0018
BP_5	Billing Period Dec-Jan	1	-0.03511	0.04437	-0.79	0.4292
CDD	Cooling degree days	1	0.00598	0.00200	2.99	0.0030
HDD	Heating degree days	1	0.00118	0.00019	6.09	<.0001
Heating_Code	Electricity as primary heating fuel	1	0.31938	0.01728	18.48	<.0001
D_Highrise	Dwelling Type: Highrise building	1	-1.55798	0.02444	-63.74	<.0001
D_Multi	Dwelling Type: Multiple Apartment Block	1	-1.49089	0.02444	-61.00	<.0001
D_Strata	Dwelling Type: Strata-Condominium	1	-0.92860	0.02444	-37.99	<.0001

When these invalid variables except for the price are excluded from the model, the result of price elasticity is -0.10, as shown in the next table. However, it was not statistically significant at the 90 percent confidence level.

Root MSE	0.19835	R-Square	0.9207
Dependent Mean	6.70386	Adj R-Sq	0.9190
Coeff Var	2.95878		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	6.61248	0.18357	36.02	<.0001
Ln_Price	Natural log of Electricity price adjusted by CPI	1	-0.10274	0.06733	-1.53	0.1276
BP_1	Billing period: April and May	1	0.19979	0.05332	3.75	0.0002
BP_2	Billing Period Aug-Sep	1	0.31097	0.09192	3.38	0.0008
BP_3	Billing Period Oct-Nov	1	0.27583	0.08991	3.07	0.0023
BP_4	Billing Period Dec-Jan	1	0.11133	0.03666	3.04	0.0025
CDD	Cooling degree days	1	0.00573	0.00198	2.89	0.0040
HDD	Heating degree days	1	0.00106	0.00014	8.16	<.0001
Heating_Code	Electricity as primary heating fuel	1	0.31938	0.01726	18.50	<.0001
D_Highrise	Dwelling Type: Highrise building	1	-1.55798	0.02442	-63.81	<.0001
D_Multi	Dwelling Type: Multiple Apartment Block	1	-1.49089	0.02442	-61.06	<.0001
D_Strata	Dwelling Type: Strata-Condominium	1	-0.92860	0.02442	-38.03	<.0001

Analysis of Step 1 Price Elasticity in 2016

Following the 2013 RIB Evaluation, Step 1 price elasticity was analysed again in 2016 with additional data for F2013 to F2015. The data series covered F2005 to F2015. This work is referred to as Round 2 analysis in Section 3 of this Report. This analysis applied the same model used in the 2013 RIB Evaluation, which has the following functional form:

$$\ln(Consumption) = \alpha + \beta \cdot Heat + \gamma \cdot Dwelling + \delta \cdot BillingPeriod + \omega 1 \cdot CDD + \omega 2 \cdot HDD$$
$$+ \text{ʒ} \cdot Region + \varepsilon \cdot ln\,(Price) + \sigma \cdot ln\,(Disposable\_Income) + \varphi \cdot C + \mu$$

The estimated Step 1 price elasticity was not statistically significant (*p*=0.5721).

Root MSE	0.02968	R-Square	0.9735
Dependent Mean	6.67393	Adj R-Sq	0.9731
Coeff Var	0.42978		

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	Intercept	1	7.51364	0.13130	57.22	<.0001
BP_1	Billing period: April and May	1	-0.05611	0.00483	-11.62	<.0001
BP_2	Billing period: June and July	1	-0.13709	0.00780	-17.59	<.0001
BP_3	Billing Period: Aug-Sep	1	-0.09863	0.00711	-13.88	<.0001
BP_4	Billing Period: Oct-Nov	1	0.02288	0.00330	6.94	<.0001
BP_5	Billing Period: Dec-Jan	1	0.06879	0.00389	17.70	<.0001
D_Reg_N	Dummy Variable of Region: North	1	-0.04957	0.00333	-14.90	<.0001
D_Reg_SI	Dummy Variable of Region: Southern Interior	1	-0.07260	0.00302	-24.05	<.0001
D_Reg_VI	Dummy Variable of Region: Vanouver Island	1	0.05999	0.00389	15.44	<.0001
D_APT	Dummy Variable of Dwell Type: Apartment Building	1	-0.67598	0.01154	-58.60	<.0001
D_ROW	Dummy Variable of Dwell Type: Row House	1	-0.24943	0.00677	-36.82	<.0001
D_MOB	Dummy Variable of Dwell Type: Mobile Home	1	-0.09079	0.00324	-28.00	<.0001
CDD	Cooling degree days	1	0.00046	0.000035	13.08	<.0001
HDD	Heating degree days	1	0.00006	0.000006	10.05	<.0001
ln_P1	Natural Logarithm of Step 2 Price	1	-0.02071	0.03069	-0.68	0.5721
ln_income	Natural Logarithm of Disposable Income	1	-0.06388	0.01090	-5.86	<.0001
C_small	correction term: small customers	1	0.17246	0.00789	21.85	<.0001

D.2. Additional Customer Insights in Relation to the RIB Rate

This section provides more detail on customers' consumption of electricity in F2017, their opinions toward their household's consumption, the price of electricity and accompanying bills, and their awareness and attitudes toward the RIB rate.

D.2.1. Customer Exposure to Step 2 Electricity Consumption

Incidence of Step 2 Electricity Consumption by Space Heating and Water Heating Fuels

Section 3.4.1 showed that customer households on Vancouver Island and those living in single detached houses were the most likely of all customers to have incurred Step 2 electricity consumption in F2017.

The incidence of having incurred Step 2 consumption in at least one month of F2017 measured evenly at 69 percent among households that primarily rely on electricity for space heating and among those that rely on non-electric fuels such as natural gas, oil or propane.

In terms of water heating fuel, the incidence of having incurred Step 2 consumption in at least one month of F2017 measured 87 percent among households that have electric hot water heaters, 75 percent among those that have non-electric hot water heaters, and just 31 percent among those who rely on hot water from a central system. The relationship is underscored by the wide differences in the proportion of these three groups that always incurred Step 2 consumption in all twelve months of the fiscal year, measuring 33 percent, 24 percent and 1 percent, respectively.

Table D.2.1: Incidence of Step 2 Electricity Consumption in F2017 by Space Heating and Water Heating Fuels

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total	Total Sometimes + Always into Step 2
Total	30%	48%	22%	100%	70%
Main Space Heating Fuel					
Electricity	31%	50%	18%	100%	69%
Non-Electric	31%	45%	24%	100%	69%
Main Water Heating Fuel					
Electricity	13%	55%	33%	100%	87%
Non-Electric	25%	51%	24%	100%	75%
No hot water tank (central)	69%	30%	1%	100%	31%
Main Space Heating and Water Heating Fuels					
Electric Heating & Electric Water	11%	59%	30%	100%	89%
Electric Heating & Non-Electric Water	15%	57%	27%	100%	85%
Electric Heating & Central Water	62%	37%	1%	100%	38%
Non-Electric Heating & Electric Water	16%	46%	39%	100%	84%
Non-Electric Heating & Non-Electric Water	26%	50%	23%	100%	74%
Non-Electric Heating & Central Water	89%	9%	2%	100%	11%

Row totals may not total 100% due to the rounding of values.

Based on the magnitude of observed differences, it may first appear that water heating fuel was a stronger determinant of Step 2 status than space heating fuel. However, there are direct and indirect interactions between the two end-uses – as well as with other housing characteristics – that must be understood.

First, electrically heated homes are comprised of a much larger share of apartments and condominiums relying on electric baseboards. These dwellings are typically much smaller in size compared to other dwellings, lower

in occupancy, have shared walls, and importantly, predominantly rely on central water heating. Second, a majority of households with electric hot water heaters also have electric space heating.

When looked at in isolation, electric space heating – in the absence of electric water heating – has a similar impact on the incidence of Step 2 consumption as does the impact of electric water heating in the absence of electric space heating. In these isolated scenarios, however, the homes with electric space heating would likely incur more Step 2 consumption in the heating season – and possibly the shoulder seasons – compared to homes with electric water heating.

Note that the incidence of having incurred Step 2 consumption climbed only marginally to 89 percent for homes that have both electric space heating and electric water heating – likely because most of these homes would already breach the threshold with only one of the two electric end-uses. However, these homes would likely incur more Step 2 consumption than those that had just one of the two electric end-uses.

Incidence of Step 2 Electricity Consumption by Household Demographics

Customers living in single detached houses have already been shown in Section 3.4.1 to have been among the most likely to have incurred Step 2 consumption in at least one month of F2017. Given the comparably higher cost of these homes and their comparably larger size, it comes expectedly that customers who own their homes, who have higher household incomes and who have the most household occupants are all among the most likely to have incurred Step 2 consumption during the year.

Table D.2.2: Incidence of Step 2 Electricity Consumption in F2017 by Household Demographics

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total	Total Sometimes + Always into Step 2
Total	30%	48%	22%	100%	70%
Home Ownership					
Own/Co-op	24%	51%	24%	100%	76%
Rent	61%	30%	10%	100%	39%
Number of Household Occupants					
1	57%	40%	3%	100%	43%
2	30%	54%	15%	100%	70%
3	18%	53%	29%	100%	82%
4 +	13%	40%	46%	100%	87%
Household Income					
Under $40,000	46%	43%	10%	100%	54%
$40,000 < $80,000	35%	48%	18%	100%	65%
$80,000 < $120,000	24%	51%	25%	100%	76%
$120,000 +	18%	50%	32%	100%	82%
Low Income Status					
Yes, 'low income' household	46%	41%	13%	100%	54%
No	30%	48%	22%	100%	70%

Row totals may not total 100% due to the rounding of values.

D.2.2. Consumption Profiles by the Incidence of Step 2 Electricity Consumption

This section presents electricity consumption patterns and insights essentially in reverse of the way presented in the previous section of this appendix. Instead of exploring customer sub-groups as to how their consumption distributes into the three unique consumption bins, each of the three consumption bins are explored as to how customer sub-groups distribute within them. Specifically, the tables detail the profiles of customer households that never (0 months), sometimes (1-11 months) and always (12 months) incurred Step 2 consumption in the twelve months of F2017.

Profile of Region and Dwelling Type by the Incidence of Step 2 Electricity Consumption

The profile of residential customers that never incurred Step 2 consumption in the twelve months of F2017 was comprised of some 70 percent of Lower Mainland households, due in large part to the greater proportion of apartments and condominiums in the region and the fact they tend to use less electricity than all other dwelling types. In fact, apartments and condominiums had a 59 percent share of all dwellings that never incurred Step 2 consumption in F2017 – 31 points higher than their overall share of dwellings in BC Hydro's service territory. Related, nearly one-half of these customers were single occupant households.

Given the breadth of the consumption bin, it comes expectedly that the profile of residential customers that sometimes incurred Step 2 consumption in F2017 generally followed that of the overall customer base.

Table D.2.3: Profile of Region and Dwelling Type by the Incidence of Step 2 Consumption in F2017

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	All Customers
Region				
Lower Mainland	70%	55%	51%	59%
Vancouver Island	15%	23%	26%	21%
Southern Interior	9%	13%	13%	12%
North	6%	9%	9%	8%
Total	100%	100%	100%	100%
Dwelling Type				
Single detached house	29%	57%	86%	54%
Duplex/Row house/townhouse	9%	17%	8%	13%
Apartment/Condominium	59%	20%	2%	28%
Mobile home/other	4%	6%	4%	5%
Total	100%	100%	100%	100%

Column totals may not total 100% due to the rounding of values.

The pool of residential customers that always incurred Step 2 consumption in F2017 was comprised of a somewhat greater share of households outside the Lower Mainland – especially on Vancouver island – as compared to their share in the population overall. This consumption bin, however, was more prominently characterized by its dwelling composition by virtue of the fact that 86 percent were single detached houses – 32 points higher than their 54 percent share across the entire service territory.

Profile of Space Heating and Water Heating Fuels by the Incidence of Step 2 Electricity Consumption

The profile of households that never incurred Step 2 consumption in the twelve months of F2017 was largely comprised of households that do not rely on electricity for either of their space heating or water heating needs.

As for households that always incurred Step 2 consumption, the share of main space heating fuels measured 39 percent electric and 61 percent non-electric. This group's profile by water heating fuel does not follow that of the overall population as it is 18 points over-represented by households with electric hot water tanks (53%) and 23 points under-represented by households without any hot water tanks at all (1%). As detailed in this appendix, these findings reflect a complex interplay of factors that influence customer exposure to Step 1 and 2 prices, including space heating, water heating, dwelling and other demographic parameters.

Table D.2.4: Profile of Space and Water Heating Fuels by the Incidence of Step 2 Consumption in F2017

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	All Customers
Main Space Heating Fuel				
Electricity	46%	48%	39%	45%
Non-Electric	54%	52%	61%	55%
Total	100%	100%	100%	100%
Main Water Heating Fuel				
Electricity	14%	41%	53%	35%
Non-Electric	33%	44%	45%	41%
No hot water tank (central)	53%	15%	1%	24%
Total	100%	100%	100%	100%
Main Space Heating and Water Heating Fuels				
Electric Heating & Electric Water	8%	29%	32%	23%
Electric Heating & Non-Electric Water	2%	5%	5%	4%
Electric Heating & Central Water	35%	14%	1%	18%
Non-Electric Heating & Electric Water	6%	11%	21%	12%
Non-Electric Heating & Non-Electric Water	31%	39%	40%	37%
Non-Electric Heating & Central Water	18%	1%	<1%	6%
Total	100%	100%	100%	100%

Column totals may not total 100% due to the rounding of values.

Profile of Household Demographics by the Incidence of Step 2 Electricity Consumption

Compared to the population of all residential customers, households that always incurred Step 2 consumption in F2017 were more likely to own their homes (91% versus 81% overall) and to have reported annual earnings of at least $80,000 (60% versus 44% overall). These findings simply reflect the fact that this consumption bin is largely comprised of single detached houses.

Table D.2.5: Profile of Household Demographics by the Incidence of Step 2 Consumption in F2017

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	All Customers
Home Ownership				
Own/Co-op	63%	88%	91%	81%
Rent	37%	12%	9%	19%
Total	100%	100%	100%	100%
Number of Household Occupants				
1	43%	19%	4%	23%
2	39%	45%	28%	40%
3	8%	15%	17%	13%
4 +	11%	21%	52%	24%
Total	100%	100%	100%	100%
Household Income				
Under $40,000	36%	22%	13%	25%
$40,000 < $80,000	34%	31%	27%	31%
$80,000 < $120,000	18%	26%	30%	24%
$120,000 +	11%	20%	30%	20%
Total	100%	100%	100%	100%
Low Income Status				
Yes, 'low income' household	16%	10%	7%	11%
No	84%	90%	93%	89%
Total	100%	100%	100%	100%

Column totals may not total 100% due to the rounding of values.

D.2.3. Customer Opinions about Managing Electricity Consumption

This section presents findings in regards to customers' opinions around managing their consumption of electricity, including their reported ease of doing so, their current effort and their change in effort over the past three years.

Ease in Managing Household Electricity Consumption

As a way to 'ease' customer respondents into the rates-related content of the 2017 survey, they were first queried about the management of their household's electricity use. Customers were reminded that they can manage their consumption of electricity by changing behaviour, purchasing energy-efficient products, making energy-efficient home upgrades and by participating in conservation programs.

Under the premise that they want to manage their use of electricity, a total of 75 percent of customers reported that it is either 'very easy' or 'somewhat easy' for them to manage their use of electricity. As detailed in Table D.2.6, this proportion measured 84 percent among customers who never incurred Step 2 electricity consumption in F2017, 74 percent among customers who sometimes incurred Step 2 electricity consumption and 64 percent among those who always did so.

Table D.2.6: Reported Ease or Difficulty in Managing Household Electricity Consumption

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total
Total very easy + somewhat easy	84%	74%	64%	75%
Very easy	34%	20%	14%	23%
Somewhat easy	50%	54%	50%	52%
Somewhat difficult	13%	22%	31%	21%
Very difficult	2%	4%	5%	4%
Total	100%	100%	100%	100%

Column totals may not total 100% due to the rounding of values.
Don't know responses have been excluded from all calculations.

Current Effort in Managing Household Electricity Consumption

A total of 67 percent of customers in the 2017 survey reported that their household was currently making either 'a great deal of effort' or 'a fair amount of effort' to manage its consumption of electricity.

Table D.2.7: Reported Effort in Managing Household Electricity Consumption

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total
Total a great deal of effort + a fair amount effort	67%	68%	65%	67%
A great deal of effort	17%	14%	12%	14%
A fair amount of effort	50%	53%	53%	52%
A little effort	26%	28%	32%	28%
No effort at all	6%	3%	2%	4%
Not applicable – there is little opportunity to do so	1%	1%	1%	1%
Total	100%	100%	100%	100%

Column totals may not total 100% due to the rounding of values.
Don't know responses have been excluded from all calculations.

Change in Effort over the Past Three Years in Managing Household Electricity Consumption

The majority of customer households – 57 percent – reported that they were currently making either 'much more of an effort' or 'a little more of an effort' to manage their consumption of electricity as compared to three years ago. This proportion measured lowest at 49 percent among customers who never incurred Step 2 electricity consumption in F2017 and highest at 63 percent among those who always did so.

Table D.2.8: Reported Change in Effort over the Past Three Years in Managing Electricity Consumption

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total
Total much more of an effort + a little more of an effort	49%	60%	63%	57%
Much more of an effort	16%	20%	21%	19%
A little more of an effort	33%	40%	42%	38%
No change	49%	37%	34%	40%
A little less of an effort	2%	2%	3%	2%
Much less of an effort	<1%	<1%	<1%	<1%
Total	100%	100%	100%	100%

Column totals may not total 100% due to the rounding of values.
Don't know responses have been excluded from all calculations.

D.2.4. Customer Opinions about Electricity Prices and their Bills

This section presents additional findings in regards to customers' opinions around their perceived price of electricity and their accompanying bills.

Electricity Prices – Value for Money

Customer respondents in the 2017 survey were asked to think about the amount of money their household pays for electricity every month, every two months or even over the course of a year, and to consider the benefits they receive in return. In total, 79 percent of customers believed that the amount of money represents either 'excellent', 'good' or 'fair' value for money. Customer opinions in this regard varied strongly with their Step 2 consumption status in F2017, measuring highest at 90 percent among customers who never incurred Step 2 electricity consumption in F2017 and lowest 67 percent among those who always did so.

Table D.2.9: Perceived Value for Money Household Pays for its Electricity Consumption

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total
Total excellent + good + fair	90%	77%	67%	79%
Excellent value for money	12%	4%	2%	6%
Good value for money	31%	22%	14%	23%
Fair value for money	46%	52%	51%	50%
Poor value for money	5%	16%	24%	14%
Very poor value for money	1%	3%	5%	3%
Don't know	4%	4%	4%	4%
Total	100%	100%	100%	100%

Column totals may not total 100% due to the rounding of values.

Total Electricity Bill

The majority of customers in the 2017 survey reported that they look over their household's electricity bill either 'at least once a month' or 'once every two months'.

Table D.2.10: Frequency of Looking over Electricity Bill (Print or Online Version)

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total
Total at least once a month + once every 2 months	78%	80%	81%	80%
At least once a month	36%	40%	39%	39%
Once every 2 months	42%	40%	43%	41%
Once every 3 months	5%	6%	5%	6%
Once every 4 to 6 months	4%	4%	4%	4%
Once or twice a year	4%	5%	4%	4%
Never – we just pay it	8%	5%	5%	6%
Total	100%	100%	100%	100%

Column totals may not total 100% due to the rounding of values.
Don't know responses have been excluded from all calculations.

Attitudes toward Household Electricity Consumption and Bills

Table D.2.11 below details customer agreement levels on four attitudinal statements related to their household's electricity consumption and the accompanying electricity bills.

Table D.2.11: Attitudes toward Household Electricity Consumption and Bills (Table 1 of 2)

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total
I spend more time looking over bills I receive than my BC Hydro bill				
Total strongly agree + somewhat agree	38%	32%	27%	33%
Strongly agree	16%	14%	13%	14%
Somewhat agree	21%	18%	14%	18%
Neither agree nor disagree	30%	32%	40%	33%
Somewhat disagree	18%	21%	16%	19%
Strongly disagree	13%	14%	16%	14%
Don't know	1%	1%	1%	1%
Total	100%	100%	100%	100%
I have a good understanding of the factors that cause changes in my household's electricity consumption				
Total strongly agree + somewhat agree	48%	51%	50%	50%
Strongly agree	22%	21%	18%	21%
Somewhat agree	25%	30%	32%	29%
Neither agree nor disagree	11%	8%	11%	10%
Somewhat disagree	23%	26%	24%	24%
Strongly disagree	16%	13%	14%	14%
Don't know	2%	2%	1%	2%
Total	100%	100%	100%	100%

Column totals may not total 100% due to the rounding of values.

Table D.2.12: Attitudes toward Household Electricity Consumption and Bills (Table 2 of 2)

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total
My BC Hydro bill is easy to understand				
Total strongly agree + somewhat agree	52%	47%	50%	49%
Strongly agree	20%	16%	15%	17%
Somewhat agree	32%	31%	34%	32%
Neither agree nor disagree	11%	16%	15%	14%
Somewhat disagree	22%	24%	25%	24%
Strongly disagree	13%	12%	10%	12%
Don't know	2%	1%	<1%	1%
Total	100%	100%	100%	100%
I usually pay my BC Hydro bill without looking over its consumption levels				
Total strongly agree + somewhat agree	45%	42%	42%	43%
Strongly agree	23%	22%	23%	22%
Somewhat agree	22%	20%	19%	21%
Neither agree nor disagree	9%	9%	11%	10%
Somewhat disagree	22%	22%	22%	22%
Strongly disagree	23%	27%	25%	25%
Don't know	<1%	<1%	<1%	<1%
Total	100%	100%	100%	100%

Column totals may not total 100% due to the rounding of values.

Reported Change in Total Electricity Bill Amounts

A total of 79 percent of customers believed that the total dollar amount of their electricity bills have either 'increased a great deal' or 'increased just a little' over the past three years. This proportion stepped up through the three consumption bins, from a low of 69 percent among customers who never incurred Step 2 electricity consumption in F2017 to a high of 86 percent among those who always did so.

Table D.2.13: Reported Change in Total Electricity Bill Amounts over the Past Three Years

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total
Total increased a great deal + increased just a little	69%	81%	86%	79%
Increased a great deal	16%	34%	46%	31%
Increased just a little	54%	47%	40%	48%
Stayed about the same	20%	10%	7%	12%
Decreased just a little	2%	3%	2%	3%
Decreased a great deal	1%	1%	1%	1%
Don't know	8%	5%	4%	5%
Total	100%	100%	100%	100%

Column totals may not total 100% due to the rounding of values.

Perceived Reasons for Change in Total Electricity Bill Amounts

Among customers who believed the total amount of their electricity bills had increased over the past three years, 78 percent believed the increase was due to changes in the overall price they pay for electricity while 28 percent (also) believed the increase was due to changes in their household's consumption level.

Table D.2.14: Perceived Reason for Change in Total Electricity Bill Amounts over the Past Three Years

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total
For those who reported increases in bills				
Due to changes in the overall price we pay for electricity	76%	79%	78%	78%
Due to changes in our consumption level	25%	31%	26%	28%
Don't know	10%	6%	10%	9%
For those who reported decreases in bills				
Due to changes in our consumption level	86%	85%	83%	85%
Due to changes in the overall price we pay for electricity	9%	16%	15%	14%
Don't know	7%	10%	8%	9%

*Totals may be greater than 100% due to multiple mentions.

Among customers who believed the total amount of their electricity bills had decreased over the past three years, 85 percent believed the decrease was due to changes in their household's consumption level while 14 percent (also) believed the decrease was due to changes in the overall price they pay for electricity.

D.2.5. Awareness and Opinions of BC Hydro's Residential Rate Structure

This section provides more detail on customers' prior awareness, understanding and opinions of BC Hydro's residential rate structure.

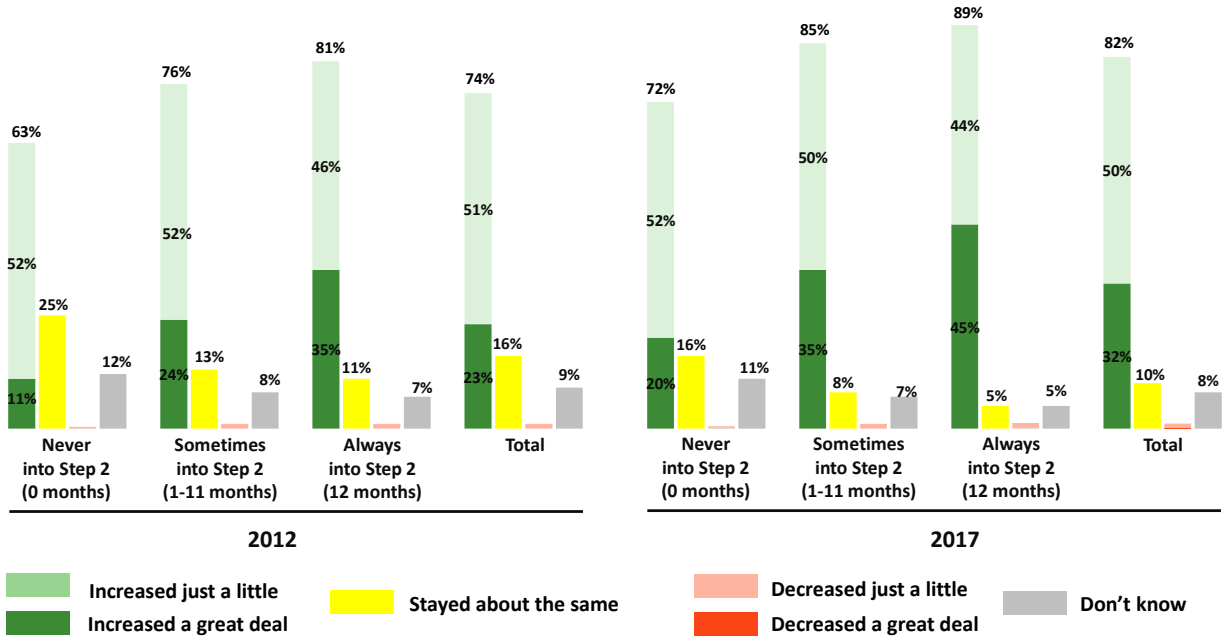
Perceived Change in BC Hydro's Current Residential Electricity Prices over the Past Three Years

In each of the 2012 and 2017 surveys, customers were also asked about the extent to which they believed residential electricity prices had changed – if at all – over the previous three years.

As illustrated in Figure D.1, 63 percent of customers that never incurred Step 2 electricity consumption in F2012 believed that electricity prices had increased over the previous three years. To compare, this proportion climbed to 76 percent among those that sometimes incurred Step 2 electricity consumption in the fiscal year and further to 81 percent that always did so.

Different insights and perspectives can be gained by bundling the 'increased just a little' and 'stayed about the same' responses during analysis. By doing so, it can be said that 77 percent of those that never incurred Step 2 electricity consumption in F2012 felt that prices had increased little – if at all – over the previous three years. To compare, this proportion measured lower at 65 percent among customers that sometimes incurred Step 2 electricity consumption and at 57 percent among those that always did so.

Figure D.1
Perceived Change in BC Hydro's Residential Electricity Prices over the Past Three Years
- By Step 2 Status of Electricity Consumption -



The findings in the 2012 survey are intuitively consistent with the actual change in electricity prices dating back to October 2008 when the RIB rate was implemented. As shown in Figure 2.1, at the time of the 2012 survey, the Step 1 price had existed for roughly 3.5 years and had been lower than the pre-RIB flat rate price for 2.5 of those years. This group would be expected to be less cognizant of price increases in these years and to be less responsive to them as compared to the two other cohorts. Analysis presented in an earlier section showed this in that a Step 1 price elasticity pertaining to that period was not detected with a high degree of confidence whereas a Step 2 price elasticity was.

The pattern of opinions toward the perceived change in electricity prices by Step 2 status identified in the 2012 survey emerged again in the 2017 survey, but with some shifts over the five year period. In each of the three Step 2 cohorts, the proportion of customers who felt that electricity prices had 'increased a great deal' over the previous three years measured higher in 2017 than in 2012. In particular, the proportion nearly doubled from 11 percent to 20 percent among the cohort that was never into Step 2. It is reasonable to believe, therefore, that this group of customers would have become comparably more responsive to an increase in electricity prices than they were five years earlier. This belief is backed by the fact that a statistically significant Step 1 price elasticity was ascertained once the F2016 and F2017 consumption data was added to the econometric analysis.

Unaided Awareness of BC Hydro's Residential Rate Structure by Region, Dwelling and Step 2 Consumption

As explained in Section 3.4.3., unaided awareness that BC Hydro uses an inclining block rate for charging residential households for their consumption of electricity measured highest at 53 percent among customer households that always incurred Step 2 electricity consumption in F2017. It follows that prior awareness of the inclining block rate continues to measure highest – 58 percent currently – among customers on Vancouver Island. These households were previously shown to have been the most likely to incur Step 2 consumption in F2017 and by extension, the most likely to have had the highest electricity bills.

Interestingly, the results of the analysis of regional elasticities in Section 3.3.1 also that showed Vancouver Island customers were more responsive to the Step 2 price than customers in other regions.

Table D.2.15: Unaided Awareness of BC Hydro's Residential Rate Structure by Region, Dwelling and Step 2 Status

	Inclining block rate	Flat rate	Declining block rate	Time of Use	Don't know	Total
Total	47%	21%	1%	8%	24%	100%
Region						
Lower Mainland	42%	23%	1%	8%	26%	100%
Vancouver Island	58%	15%	1%	7%	19%	100%
Southern Interior	49%	19%	1%	7%	25%	100%
North	45%	21%	1%	7%	26%	100%
Dwelling Type						
Single detached house	53%	19%	1%	7%	20%	100%
Duplex/Row house/townhouse	43%	20%	<1%	10%	27%	100%
Apartment/Condominium	37%	25%	1%	8%	29%	100%
Mobile home/other	49%	12%	1%	6%	31%	100%
Step 2 Consumption Status in F2017						
Never into Step 2 (0 months)	39%	23%	1%	9%	28%	100%
Sometimes into Step 2 (1-11 months)	49%	20%	1%	7%	23%	100%
Always into Step 2 (12 months)	53%	19%	<1%	8%	20%	100%

Row totals may not total 100% due to the rounding of values.

Consistent with findings tied to education and income, unaided awareness of the inclining block rate measured highest among customers who own single detached houses – the most expensive of the dwelling types, and typically the highest in consumption.

Unaided Awareness of BC Hydro's Residential Rate Structure by Household Demographics

Unaided awareness of the inclining block rate was strongly correlated to level of education, spanning 21 points from a low of 34 percent among customers who have earned no more than a high school diploma to a high of 55 percent among those who have attained university degrees. Related, awareness was also tied to annual income, spanning 19 points from a low of 37 percent among those with household earnings less than $40,000 to a high of 56 percent among those with household earnings of at least $120,000. Note that educated and affluent consumers are among the most likely to live in single detaches houses which have been shown to be the most likely of all dwellings to incur Step 2 electricity consumption. These customers are also known to be comparably more likely than others to be regular readers of public affairs information – conventionally in newspapers, but also online – in which electricity issues and rates are often covered.

Table D.2.16: Unaided Awareness of BC Hydro's Residential Rate Structure by Household Demographics

	Inclining block rate	Flat rate	Declining block rate	Time of Use	Don't know	Total
Total	47%	21%	1%	8%	24%	100%
Home Ownership						
Own/Co-op	49%	20%	1%	8%	22%	100%
Rent	36%	24%	1%	7%	33%	100%
Age of Primary Account Holder						
18-34	47%	23%	1%	6%	22%	100%
35-54	46%	23%	1%	8%	22%	100%
55+	47%	18%	1%	8%	26%	100%
Education of Primary Account Holder						
High school or less	34%	19%	1%	10%	37%	100%
College/vocational/technical/some university	47%	20%	1%	8%	23%	100%
University/Graduate Degree	55%	22%	1%	6%	17%	100%
Household Income						
Under $40,000	37%	18%	2%	8%	34%	100%
$40,000 < $80,000	47%	20%	1%	8%	24%	100%
$80,000 < $120,000	52%	20%	<1%	8%	20%	100%
$120,000 +	56%	25%	<1%	6%	13%	100%
Low Income Status						
Yes, 'low income' household	33%	20%	2%	10%	34%	100%
No	48%	21%	1%	7%	23%	100%

Row totals may not total 100% due to the rounding of values.

Consistent with other BC Hydro research, approximately 10 percent of the customer households in the 2017 surveys were classified as 'low income'. Among these customers, unaided awareness of the RIB rate measured 33 percent.

Unaided Awareness of BC Hydro's Residential Rate Structure by Heating Fuels

There was no meaningful difference in unaided awareness of the inclining block rate among customers who rely on electricity to heat their homes versus those who rely on natural gas, oil or propane (46% versus 47%). However, at 54 percent, customers who rely on electricity for their water heating were more likely than others to have been aware of the rate. To compare, this proportion decreased to 47 percent among customers with non-electric hot water tanks and further to 36 percent among those with central water heating. As previously explained, all of these findings reflect a complex interplay of factors that influence customer awareness of electricity rate structures, including space heating, water heating, dwelling and other demographic parameters.

Table D.2.17: Unaided Awareness of BC Hydro's Residential Rate Structure by Heating Fuels

	Inclining block rate	Flat rate	Declining block rate	Time of Use	Don't know	Total
Total	47%	21%	1%	8%	24%	100%
Main Space Heating Fuel						
Electricity	46%	19%	1%	7%	27%	100%
Non-Electric	47%	22%	1%	8%	22%	100%
Main Water Heating Fuel						
Electricity	54%	17%	1%	7%	22%	100%
Non-Electric	47%	21%	1%	8%	23%	100%
No hot water tank (central)	36%	25%	1%	8%	29%	100%
Main Space Heating and Water Heating Fuels						
Electric Heating & Electric Water	52%	17%	<1%	7%	23%	100%
Electric Heating & Non-Electric Water	51%	15%	0%	9%	25%	100%
Electric Heating & Central Water	37%	23%	1%	7%	32%	100%
Non-Electric Heating & Electric Water	56%	16%	1%	8%	19%	100%
Non-Electric Heating & Non-Electric Water	46%	22%	1%	8%	23%	100%
Non-Electric Heating & Central Water	36%	31%	<1%	10%	22%	100%

Row totals may not total 100% due to the rounding of values.

Understanding of the RIB Rate

After first soliciting their awareness of the method BC Hydro uses for charging their household's consumption of electricity, the survey informed respondents that an inclining block rate is indeed the method that BC Hydro uses. In doing so, the method was also introduced as BC Hydro's Two-Step Residential Conservation Rate and the Step 1 to Step 2 threshold and prices were detailed.

Table D.2.18: Understanding of the RIB Rate by the Incidence of Step 2 Electricity Consumption in F2017

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total
Total excellent + good + fair	37%	47%	51%	44%
Excellent	7%	14%	16%	12%
Good	19%	21%	24%	21%
Fair	11%	12%	11%	11%
Poor	1%	2%	2%	2%
Very poor	<1%	<1%	<1%	<1%
Don't know	<1%	<1%	<1%	<1%
Not aware of the RIB rate	61%	51%	47%	53%
Total	100%	100%	100%	100%

Column totals may not total 100% due to the rounding of values.

Having read the details about BC Hydro's Two-Step Residential Conservation Rate, a total of 44 percent of customers felt they actually had either an 'excellent', 'good' or 'fair' understanding of the rate prior to receiving the survey – this included some 33 percent professing either an 'excellent' or a 'good' understanding of it. These findings are generalizable to the entire population of BC Hydro's residential customers charged on this rate because the figures are fully based – the 53 percent of customers identified as not being previously aware that their consumption of electricity is charged on the RIB rate have not been excluded.

Closely following unaided awareness that residential electricity consumption is charged on an inclining block rate, the extent that customers understood the details of the RIB rate increased with the frequency of exposure to Step 2 consumption. While a total of 37 percent of customer households that never incurred Step 2 consumption in the twelve months of F2017 emerged to have either an 'excellent', 'good' or 'fair' understanding of the rate, this proportion increased to 47 percent among customers that sometimes incurred Step 2 consumption and further to 51 percent among customers that always incurred Step 2 consumption during this period.

Reported Change in 'Mindfulness' of Electricity Consumption over the Past Three Years

Among customers previously aware of the RIB rate, a total of 48 percent of them report that they have become either 'much more mindful' or 'somewhat more mindful' over the past three years of their consumption of electricity in relation to the Step 1 and Step 2 prices and thresholds.

Table D.2.19: Reported Change in 'Mindfulness' of Electricity Consumption over the Past Three Years

- among customers previously aware of the RIB rate –

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total
Total much more mindful + somewhat more mindful	43%	52%	46%	48%
Much more mindful	11%	13%	13%	13%
Somewhat more mindful	32%	38%	33%	35%
No change	55%	47%	52%	51%
Somewhat less mindful	1%	1%	1%	1%
Much less mindful	1%	0%	1%	<1%
Total	100%	100%	100%	100%

Column totals may not total 100% due to the rounding of values.
Don't know responses have been excluded from all calculations.

Awareness that the RIB Rate was Designed to Encourage Conservation

Among customers who correctly identified the inclining block rate as the method that BC Hydro uses for charging their household's consumption of electricity, 77 percent reported having been previously aware that the rate was designed to encourage conservation.

Table D.2.20: Awareness that the RIB Rate was Designed to Encourage the Conservation of Electricity

- among customers previously aware of the RIB rate -

	Yes, previously aware	No, not previously aware	Total
Region			
Lower Mainland	77%	23%	100%
Vancouver Island	80%	20%	100%
Southern Interior	75%	25%	100%
North	73%	27%	100%
Step 2 Consumption Status in F2017			
Never into Step 2 (0 months)	79%	21%	100%
Sometimes into Step 2 (1-11 months)	79%	21%	100%
Always into Step 2 (12 months)	73%	27%	100%
Education of Primary Account Holder			
High school or less	73%	27%	100%
College/vocational/technical/some university	74%	26%	100%
University/Graduate Degree	82%	18%	100%
Low Income Status			
Yes, 'low income' household	74%	26%	100%
No	77%	23%	100%

Row totals may not total 100% due to the rounding of values.

Awareness that the RIB rate was designed to encourage the conservation of electricity was correlated to education level, stepping up from a low of 73 percent among those who have attained no more than a high school diploma to a high of 82 percent among those who have earned university degrees. Again, this may reflect the fact that the most educated consumers are known to be more regular readers of newspapers in which electricity issues and rates are often covered.

How the RIB Rate Provides an Incentive to Manage Electricity

In each of the 2012 and 2017 surveys, customers who correctly identified the inclining block rate as the method that BC Hydro uses for charging their household's consumption of electricity and said it serves as an incentive to manage their use of it were further queried as to just how the rate acts as a motivator.

The single largest segment of these customers in 2017 – 32 percent – reported that the difference between the Step 1 and Step 2 prices acts as an incentive to their household to manage its consumption of electricity. These customers indicated that if they can manage their use of electricity effectively in a billing period, then they can have most of it charged at the lower, Step 1 price, perhaps even avoiding Step 2 consumption and the higher, Step 2 price altogether. This sentiment measured even higher at 37 percent specifically among customers that sometimes incurred Step 2 consumption in F2017 – possibly reflecting success in this regard.

One in five customers – specifically, 21 percent in 2017 – continued to say that the lower, Step 1 price on its own acts as an incentive to their household. They consider the lower, Step 1 price as being the price applicable to all of their electricity consumption in a billing period, and they try to manage their consumption of

electricity on that basis. At 41 percent, it comes intuitively that this was the most prevalent view specifically among households that never incurred Step 2 consumption in F2017.

Table D.2.21: How the RIB Rate Provides an Incentive to Manage Electricity - among customers previously aware of the RIB Rate and who said it serves as an incentive in 2017 -

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total
The lower, Step 1 price on its own incents our household…	41%	14%	8%	21%
The higher, Step 2 price on its own incents our household…	4%	12%	17%	11%
The difference between the Step 1 and Step 2 prices incents our household…	28%	37%	26%	32%
The consumption threshold on its own incents our household…	15%	17%	18%	17%
The stepped rate does not incent my household in any of these particular ways…	9%	17%	25%	16%
Don't know	2%	3%	6%	4%
Total	100%	100%	100%	100%

Column totals may not total 100% due to the rounding of values.
Binning of Step 2 status is based on electricity consumption in F2017.

Just 11 percent of customers with proven awareness of the inclining block rate in 2017 felt that the higher, Step 2 price on its own serves as an incentive to their household to manage its use of electricity. As was the case in 2012, these customers consider the higher, Step 2 price as being the price applicable to the part of electricity consumption in a billing period that they have control over, and they try to manage their use of electricity on that basis.

A total of 17 percent of customers reported that price does not manifest itself in any of these ways as an incentive to them to manage their use of electricity; instead, they point to the consumption threshold. For these customers, regardless of the difference in the Step 1 and 2 prices and the amount they pay on their bill, they compare their household's consumption to the Step 1 to Step 2 threshold simply because they like to keep their consumption as low as possible compared to it.

Although they understood that their household's consumption of electricity is charged on an inclining block rate and they said that the rate serves as an incentive to their household to manage its use of it, 16 percent of customers in 2017 subsequently reported that the rate does not incent their household to manage its consumption of electricity in any of the four ways as presented. It is not clear if these particular customers are indeed incented by the rate in some different way, or if they were inconsistent in their responses.

Once again, results from the 2012 survey were by and large the same as those in the 2017 survey.

Customer Support of the RIB Rate

High level findings in regard to customer opinion of the RIB rate were reported in Section 3.4.3. Table D.2.22 below details the findings by region, dwelling type, Step 2 consumption status in F2017 and low income status.

Table D.2.22: Customer Support of the RIB Rate

	Don't know	Strongly oppose	Somewhat oppose	Indifferent	Somewhat support	Strongly support	Total	Total support
Total	8%	8%	11%	18%	35%	20%	100%	55%
Region								
Lower Mainland	9%	5%	9%	18%	37%	22%	100%	59%
Vancouver Island	6%	12%	15%	19%	30%	18%	100%	48%
Southern Interior	6%	10%	14%	19%	35%	16%	100%	51%
North	9%	12%	11%	21%	33%	14%	100%	47%
Dwelling Type								
Single detached house	7%	11%	12%	18%	34%	18%	100%	52%
Duplex/Row house/townhouse	11%	5%	11%	19%	35%	18%	100%	54%
Apartment/Condominium	9%	3%	8%	18%	37%	26%	100%	63%
Mobile home/other	8%	11%	17%	27%	25%	13%	100%	38%
Step 2 Consumption Status in F2017								
Never into Step 2 (0 months)	8%	3%	6%	15%	37%	31%	100%	68%
Sometimes into Step 2 (1-11 months)	8%	9%	11%	20%	35%	17%	100%	52%
Always into Step 2 (12 months)	7%	14%	17%	20%	30%	12%	100%	42%
Awareness of the RIB rate								
Previously aware of RIB rate	2%	12%	14%	15%	34%	23%	100%	57%
Not previously aware	13%	5%	8%	21%	35%	18%	100%	53%
Low Income Status								
Yes, 'low income' household	14%	6%	9%	17%	31%	22%	100%	53%
No	7%	8%	11%	18%	35%	20%	100%	55%

Row totals may not total 100% due to the rounding of values.

Reported Change in Support of the RIB Rate over the Past Three Years

Among customers who were previously aware of the RIB rate in the 2017 survey, the majority – 58 percent – said that there had been 'no change' over the past three years in their opinion of it. On the other hand, a total of 19 percent said that they had become more supportive of it while 20 percent said that they had become more opposed to it. As detailed in the table below, customers who had never incurred Step 2 electricity consumption in F2017 were the most likely to have become more supportive of the RIB rate.

Table D.2.23: Reported Change in Support of the RIB Rate over the Past Three Years

– among customers who correctly identify being charged on the RIB rate –

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total
Total much more supportive + somewhat more supportive	28%	18%	12%	19%
Much more supportive of it	9%	5%	3%	5%
Somewhat more supportive of it	19%	13%	10%	14%
No change	61%	58%	55%	58%
Somewhat more opposed to it	4%	12%	14%	10%
Much more opposed to it	3%	10%	15%	10%
Don't know	1%	1%	1%	1%
Not Applicable – not aware of the RIB rate 3 years ago	1%	2%	2%	2%
Total	100%	100%	100%	100%

Column totals may not total 100% due to the rounding of values.

D.2.6. Customer Behaviour in Relation to Awareness of the RIB Rate

This section presents detailed findings of how electricity consumption, investments in home energy efficiency upgrades and conservation program participation levels differ among RIB-aware and RIB-unware customers.

Electricity Consumption by RIB Rate Awareness

As a first investigation into the relationship between consumption and awareness, an ANOVA (analysis of variance) statistical test showed that the pool of customer households previously aware of the RIB rate incurred significantly higher average consumption in F2017 than the pool of customers not previously aware of the rate (10,447 kWh versus 8,707 kWh). In fact, while the differences were not always statistically significant at the 95 percent confidence level, RIB-aware customers incurred higher consumption in every scenario shown Table D.2.24. As customers aware of the rate would likely never choose to deliberately consume more electricity, the findings uncover a causal path: greater consumption leads to a greater likelihood of being aware of the rate.

Table D.2.24: ANOVA Tests: Mean Electricity Consumption in F2017 by RIB Rate Awareness

	Customers aware of the RIB Rate (kWh)	Customers not aware of the RIB Rate (kWh)	Difference between groups (kWh)	F Statistic of Difference	Significance
All Customers					
Total F2017 consumption ⇒	10,447	8,707	1,740	44.38	0.000*
Total Step 1 consumption ⇒	6,305	5,777	528	49.26	0.000*
Total Step 2 consumption ⇒	4,142	2,930	1,212	30.94	0.000*
Customers Never into Step 2 (0 months)					
Total F2017 consumption ⇒	3,517	3,339	178	3.37	0.067**
Total Step 1 consumption ⇒	3,517	3,339	178	3.37	0.067**
Total Step 2 consumption ⇒	-	-	-	-	-
Customers Sometimes into Step 2 (1-11 months)					
Total F2017consumption ⇒	9,858	9,159	699	12.67	0.000*
Total Step 1 consumption ⇒	6,886	6,726	160	7.59	0.006*
Total Step 2 consumption ⇒	2,972	2,433	539	10.52	0.001*
Customers Always into Step 2 (12months)					
Total F2017 consumption ⇒	19,083	17,806	1,277	3.08	0.080**
Total Step 1 consumption ⇒	8,122	8,122	0	0.00	1.000
Total Step 2 consumption ⇒	10,960	9,684	1,277	3.08	0.080**

* The difference between mean consumption levels is statically significant at the 95% level of confidence.
** The difference between mean consumption levels is statically significant at the 90% level of confidence.

In a second investigation, a linear regression was conducted with consumption as the dependent variable. The independent variables consisted of rate awareness as well as various combinations of region, dwelling type, heating fuel, floor area, income, household occupants, and saturation levels of some major end-uses.

The coefficient for the awareness variable always emerged positive in the models, but typically not statistically significant at the 95 percent level of confidence. This meant that in the estimation of a household's electricity consumption using these models, the estimate would sometimes increase – but never decrease – if the household was aware of the inclining block rate. As gleaned from both investigations, awareness of the rate does not directly lead households to having lower consumption as strictly compared to households unaware of the rate.

However, compared over time, households aware of the RIB rate may have had higher energy savings in F2017 than had they not been aware of the rate and/or higher energy savings than in periods prior to becoming aware of the rate. To investigate this, a much larger dataset of customer accounts would be required, including a long time series of consumption history both before and after households became aware of the RIB as disaggregated by a finely specified date variable.

Investments in Home Energy Efficiency Upgrades by Awareness of the RIB Rate

Those who knew that their consumption of electricity was charged on the RIB rate were slightly more likely than others to have completed at least one of the eight upgrades investigated (52% vs. 48%), including more likely to have completed draft proofing upgrades (21% vs. 15%) and insulation upgrades (16% vs. 12%).

Table D.2.25: Investments in Home Energy Efficiency Upgrades by Awareness of the RIB Rate

	Customers aware of the RIB Rate	Customers not aware of the RIB Rate	Difference between groups
Net Total: Any of the upgrades			
All customers	52%	48%	4 points*
Low income customers	44%	34%	10 points
Hot water tank installation/upgrade			
All customers	30%	28%	2 points
Low income customers	15%	15%	0 points
Window upgrades			
All customers	24%	22%	2 points
Low income customers	23%	17%	6 points
Draftproofing upgrades			
All customers	21%	15%	6 points*
Low income customers	19%	14%	5 points
Door upgrades			
All customers	17%	16%	1 point
Low income customers	12%	12%	0 points
Insulation upgrades			
All customers	16%	12%	4 points*
Low income customers	15%	4%	11 points *
Furnace installation/upgrade			
All customers	12%	12%	0
Low income customers	5%	8%	(-3) points
Air source heat pump installation/upgrade			
All customers	4%	3%	1 point
Low income customers	1%	0%	1 point
Ground source heat pump installation/upgrade			
All customers	1%	1%	0
Low income customers	0%	1%	(-1) point

* Statistically significant difference between the two groups at the 95% level of confidence.

Low income customers previously aware of the RIB rate were more likely than other low income customers to have completed some home energy-efficiency upgrades. Once again, the differences were not always statistically significant because the absolute number of low income households in the survey was not large enough to afford a high level of confidence in the findings.

Program Participation by RIB Rate Awareness

BC Hydro offers several energy conservation initiatives and rebate offerings to its residential customers to encourage them to improve energy efficiency and to adopt more energy conscious behaviours in their homes. An investigation into these programs was conducted to assist in understanding whether there were differences in program participation among those who correctly understood their use of electricity was charged on the RIB rate as compared to other customers.

This procedure relied on customer program participation markers from BC Hydro's billing system, strictly since the implementation of the RIB rate in October 2008, and customer awareness of the RIB rate.

Table D.2.26: Program Participation since RIB Rate Inception by Awareness of the RIB Rate

	Customers aware of the RIB Rate	Customers not aware of the RIB Rate	Difference between groups
Net: Any of the Programs (excludes Energy Visualization Portlet)			
All customers	32%	22%	10 points*
Low income customers	30%	25%	5 points
Appliance Rebate Program			
All customers	14%	9%	5 points *
Low income customers	8%	4%	4 points
Refrigerator Buy-Back Program			
All customers	7%	7%	0 points
Low income customers	7%	5%	2 points
Low Income Program			
All customers	4%	4%	0 points
Low income customers	16%	13%	3 points
HERO Program			
All customers	<1%	<1%	0 points
Low income customers	0%	0%	0 points
Team Power Smart Residential Behavior Program			
All customers	14%	6%	8 points *
Low income customers	14%	7%	7 points *
Energy Visualization Portlet			
All customers	29%	15%	14 points *
Low income customers	27%	14%	13 points *

* Statistically significant difference between the two groups at the 95% level of confidence.

Customers who understood that their household's consumption of electricity is charged on the RIB rate emerged to be more likely than other customers to have participated in the Residential Behaviour Program (14% vs. 6%) and the Appliance Rebate Program (14% vs. 9%) since the rate came into effect in October 2008. In addition, these RIB aware customers were more likely to have signed-up on BC Hydro's website to be able to view their detailed electricity use by the month, week, day or even hour.

Low income customers previously aware of the RIB rate were more likely than other low income customers to have participated in some conservation programs. The differences were not always statistically significant because the absolute number of low income households in the survey was not large enough to afford a high level of confidence in the findings.

In-Home Behaviours by RIB Rate Awareness

The customer survey was comprised of several banks of questions about in-home conservation behaviours. The tables in this section of the report document the self-reported frequency that individuals and/or their households typically exhibit. Findings are detailed for those aware of the RIB rate and those unaware of the rate – within the entire customer class as well as among low income customers. Statistical testing was based on aggregated or pooled data.

Frequency scores in the tables are based on the 4-point scales ('always', 'usually', 'occasionally', 'never') extensively utilized in the surveys. For any behaviour, statistical testing focused on the difference between the RIB-aware and RIB-unaware customer groups in the top-box score ('always') as well as the top-two box score ('always' + 'usually') as it is the difference in these categories that might help illuminate what might be behind any differences in the groups' actual energy consumption.

Given the large sample size for the entire customer class, statistically significant differences can emerge between RIB-aware and RIB-unaware customers for the smallest of gaps – even 2 percentage points. With this in mind, it is important to note that statistically significant differences in scores do not necessarily equate to meaningful differences in behaviours.

On the other hand, the pool of low income customer households is comparably smaller, and as such differences between RIB-aware and RIB-unaware customers were not always statistically significant because the absolute number of low income households in the survey was not large enough to afford a high level of confidence in the findings.

Plug-Load Behaviours

Table D.2.27: Plug-Load Behaviours

	Never	Occasionally	Usually	Always	Total	Total Always + Usually
Turn off the TV when no one is in the room or actively watching a program						
All Customers						
Previously aware of RIB rate	1%	5%	33%	62%*	100%	95%**
Not previously aware	3%	8%	33%	56%	100%	89%
Low Income Customers						
Previously aware of RIB rate	0%	5%	25%	70%*	100%	95%
Not previously aware	2%	9%	31%	57%	100%	88%
Turn off computer and printer when not in use OR use the power-save mode						
All Customers						
Previously aware of RIB rate	4%	8%	29%	58%	100%	87%**
Not previously aware	5%	12%	26%	57%	100%	83%
Low Income Customers						
Previously aware of RIB rate	2%	7%	29%	62%	100%	91%
Not previously aware	1%	11%	29%	60%	100%	88%

Row totals may not total 100% due to the rounding of values.
Not applicable and Don't Know responses have been excluded from all calculations.
* Statistically significant difference between the two groups' top-box score ('always') at the 95% level of confidence.
** Statistically significant difference between the two groups' top-two box score ('always' + 'usually') at the 95% level of confidence.

Lighting Behaviours

Table D.2.28: Lighting Behaviours

	Never	Occasionally	Usually	Always	Total	Total Always + Usually
Turn off lights when no one is in the room						
All Customers						
Previously aware of RIB rate	<1%	4%	39%	57%	100%	96%**
Not previously aware	1%	5%	33%	61%*	100%	94%
Low Income Customers						
Previously aware of RIB rate	0%	2%	31%	67%	100%	98%
Not previously aware	1%	3%	25%	71%	100%	96%
Only have the minimum number of lights on in a room for what I am doing						
All Customers						
Previously aware of RIB rate	1%	5%	47%	48%	100%	95%**
Not previously aware	1%	7%	39%	52%*	100%	92%
Low Income Customers						
Previously aware of RIB rate	0%	1%	37%	62%	100%	99%**
Not previously aware	<1%	6%	29%	64%	100%	94%
Purchase the most energy-efficient light bulbs, even if they are more expensive						
All Customers						
Previously aware of RIB rate	4%	20%	35%	41%*	100%	76%
Not previously aware	4%	22%	37%	37%	100%	74%
Low Income Customers						
Previously aware of RIB rate	5%	16%	30%	49%*	100%	79%
Not previously aware	5%	25%	32%	38%	100%	70%

Row totals may not total 100% due to the rounding of values.
Not applicable and Don't Know responses have been excluded from all calculations.
* Statistically significant difference between the two groups' top-box score ('always') at the 95% level of confidence.
** Statistically significant difference between the two groups' top-two box score ('always' + 'usually') at the 95% level of confidence.

Space Heating Behaviours

Table D.2.29: Space Heating Behaviours

	Never	Occasionally	Usually	Always	Total	Total Always + Usually
Dress more warmly in cold weather and reduced/keep the thermostat to 20 ° Celsius (68 ° Fahrenheit) or below						
All Customers						
Previously aware of RIB rate	9%	16%	36%	39%	100%	75%
Not previously aware	11%	17%	33%	39%	100%	72%
Low Income Customers						
Previously aware of RIB rate	8%	10%	35%	47%	100%	82%
Not previously aware	10%	18%	30%	42%	100%	72%
Use a communicating/programmable thermostat or manually turn down the heat at night						
All Customers						
Previously aware of RIB rate	12%	5%	18%	66%*	100%	84%**
Not previously aware	13%	8%	24%	55%	100%	79%
Low Income Customers						
Previously aware of RIB rate	21%	5%	17%	57%	100%	74%
Not previously aware	18%	8%	27%	48%	100%	75%
Use a communicating/programmable thermostat or manually turn down the heat when no one is home						
All Customers						
Previously aware of RIB rate	11%	9%	20%	60%*	100%	80%**
Not previously aware	13%	11%	23%	53%	100%	76%
Low Income Customers						
Previously aware of RIB rate	20%	2%	21%	57%	100%	78%
Not previously aware	13%	13%	27%	47%	100%	74%
Reduce temperature in unused rooms by closing vents or turning down thermostats						
All Customers						
Previously aware of RIB rate	13%	12%	25%	50%*	100%	75%
Not previously aware	15%	13%	26%	46%	100%	72%
Low Income Customers						
Previously aware of RIB rate	15%	6%	25%	54%	100%	80%
Not previously aware	9%	14%	24%	53%	100%	77%
Maintain the temperature of your home specifically for your dog(s) or cat(s) when no one is home						
All Customers						
Previously aware of RIB rate	53%	15%	18%	14%	100%	32%
Not previously aware	41%	19%	20%	20%*	100%	40%**
Low Income Customers						
Previously aware of RIB rate	41%	14%	16%	29%	100%	45%
Not previously aware	32%	20%	25%	22%	100%	48%

Row totals may not total 100% due to the rounding of values.
Not applicable and Don't Know responses have been excluded from all calculations.
* Statistically significant difference between the two groups' top-box score ('always') at the 95% level of confidence.
** Statistically significant difference between the two groups' top-two box score ('always' + 'usually') at the 95% level of confidence.

Space Cooling Behaviours

Table D.2.30: Space Cooling Behaviours

	Never	Occasionally	Usually	Always	Total	Total Always + Usually
Have the air conditioning come on only when it is 26° Celsius (79° Fahrenheit) or higher during the summer to save energy						
All Customers						
Previously aware of RIB rate	21%	19%	28%	32%	100%	60%
Not previously aware	20%	19%	34%	27%	100%	61%
Low Income Customers						
Previously aware of RIB rate	14%	7%	51%	27%	100%	78%
Not previously aware	20%	18%	36%	26%	100%	62%
Draw the window coverings during hot weather to reduce heat in the dwelling						
All Customers						
Previously aware of RIB rate	4%	7%	29%	60%	100%	89%**
Not previously aware	5%	10%	29%	56%	100%	85%
Low Income Customers						
Previously aware of RIB rate	2%	5%	37%	56%	100%	93%
Not previously aware	5%	15%	34%	46%	100%	80%
Clean the air conditioning filter and coils at least once per season						
All Customers						
Previously aware of RIB rate	7%	16%	23%	54%*	100%	77%**
Not previously aware	11%	18%	26%	46%	100%	71%
Low Income Customers						
Previously aware of RIB rate	4%	16%	32%	48%	100%	80%
Not previously aware	14%	17%	23%	46%	100%	69%
Cool only the rooms to be occupied rather than the whole home						
All Customers						
Previously aware of RIB rate	16%	13%	24%	48%	100%	72%
Not previously aware	16%	9%	27%	48%	100%	75%
Low Income Customers						
Previously aware of RIB rate	7%	9%	19%	66%	100%	84%
Not previously aware	4%	19%	34%	43%	100%	77%
Use air conditioning only when very hot and natural ventilation is insufficient						
All Customers						
Previously aware of RIB rate	5%	10%	29%	56%	100%	85%
Not previously aware	5%	8%	29%	58%	100%	87%
Low Income Customers						
Previously aware of RIB rate	2%	11%	18%	69%	100%	87%
Not previously aware	12%	9%	29%	50%	100%	79%

Row totals may not total 100% due to the rounding of values.
Not applicable and Don't Know responses have been excluded from all calculations.
* Statistically significant difference between the two groups' top-box score ('always') at the 95% level of confidence.
** Statistically significant difference between the two groups' top-two box score ('always' + 'usually') at the 95% level of confidence.

Laundry Behaviours

Table D.2.31: Laundry Behaviours (in own home only)

	Never	Occasionally	Usually	Always	Total	Total Always + Usually
Only do laundry with full loads						
All Customers						
Previously aware of RIB rate	1%	5%	48%	47%	100%	95%**
Not previously aware	1%	8%	44%	47%	100%	91%
Low Income Customers						
Previously aware of RIB rate	4%	5%	37%	54%	100%	91%
Not previously aware	4%	6%	37%	54%	100%	90%
Use cold water wash and rinse when doing laundry						
All Customers						
Previously aware of RIB rate	6%	22%	33%	39%	100%	72%
Not previously aware	6%	19%	30%	45%*	100%	75%
Low Income Customers						
Previously aware of RIB rate	6%	31%	24%	39%	100%	63%
Not previously aware	10%	20%	22%	48%	100%	70%
Clean the lint filter before drying clothes						
All Customers						
Previously aware of RIB rate	<1%	3%	15%	82%*	100%	97%**
Not previously aware	1%	4%	16%	79%	100%	95%
Low Income Customers						
Previously aware of RIB rate	0%	3%	5%	92%*	100%	97%
Not previously aware	4%	3%	15%	78%	100%	93%
Use the temperature/moisture sensor to turn off the dryer rather than use the timer						
All Customers						
Previously aware of RIB rate	17%	11%	22%	50%*	100%	72%**
Not previously aware	27%	11%	21%	41%	100%	62%
Low Income Customers						
Previously aware of RIB rate	10%	10%	15%	64%*	100%	80**
Not previously aware	29%	8%	20%	43%	100%	63%
Hang clothes to dry rather than machine dry						
All Customers						
Previously aware of RIB rate	21%	46%	21%	11%	100%	32%
Not previously aware	20%	49%	18%	13%	100%	31%
Low Income Customers						
Previously aware of RIB rate	29%	30%	19%	22%	100%	41%
Not previously aware	19%	41%	21%	19%	100%	40%

Row totals may not total 100% due to the rounding of values.
Not applicable and Don't Know responses have been excluded from all calculations.
* Statistically significant difference between the two groups' top-box score ('always') at the 95% level of confidence.
** Statistically significant difference between the two groups' top-two box score ('always' + 'usually') at the 95% level of confidence.

Dishwashing Behaviours

Table D.2.32: Dishwashing Behaviours

	Never	Occasionally	Usually	Always	Total	Total Always + Usually
Only turn on the dishwasher when it is full						
All Customers						
Previously aware of RIB rate	1%	2%	21%	76%	100%	97%**
Not previously aware	1%	4%	21%	74%	100%	95%
Low Income Customers						
Previously aware of RIB rate	1%	5%	17%	77%	100%	94%**
Not previously aware	5%	12%	13%	70%	100%	83%
Air dry the dishes in the dishwasher rather than use the dry cycle						
All Customers						
Previously aware of RIB rate	30%	22%	17%	31%*	100%	48%**
Not previously aware	34%	23%	15%	28%	100%	43%
Low Income Customers						
Previously aware of RIB rate	18%	21%	22%	40%	100%	61%
Not previously aware	30%	21%	16%	34%	100%	49%

Row totals may not total 100% due to the rounding of values. Not applicable and Don't Know responses have been excluded from all calculations.
* Statistically significant difference between the two groups' top-box score ('always') at the 95% level of confidence.
** Statistically significant difference between the two groups' top-two box score ('always' + 'usually') at the 95% level of confidence.

Behaviours Relating to Water Use

Table D.2.33: Behaviours Relating to Water Use

	Never	Occasionally	Usually	Always	Total	Total Always + Usually
Keep shower times to no more than 5 minutes each						
All Customers						
Previously aware of RIB rate	20%	29%	35%	16%	100%	51%
Not previously aware	22%	30%	31%	17%	100%	48%
Low Income Customers						
Previously aware of RIB rate	19%	33%	26%	23%	100%	48%
Not previously aware	24%	32%	28%	16%	100%	44%
Turn off the water heater when no one is in the home for more than 2-3 days [a]						
All Customers						
Previously aware of RIB rate	59%	12%	11%	18%*	100%	29%
Not previously aware	63%	12%	12%	14%	100%	25%
Low Income Customers						
Previously aware of RIB rate	45%	19%	12%	24%	100%	36%
Not previously aware	55%	16%	14%	14%	100%	29%

Row totals may not total 100% due to the rounding of values. Not applicable and Don't Know responses have been excluded from all calculations.
a. Only among homes with hot water tanks.
* Statistically significant difference between the two groups' top-box score ('always') at the 95% level of confidence.
** Statistically significant difference between the two groups' top-two box score ('always' + 'usually') at the 95% level of confidence.

Other Behaviours

Table D.2.34: Other Behaviours

	Never	Occasionally	Usually	Always	Total	Total Always + Usually
Think about ways to save electricity						
All Customers						
Previously aware of RIB rate ⇒	1%	26%	45%	27%	100%	73%**
Not previously aware ⇒	3%	31%	39%	27%	100%	66%
Low Income Customers						
Previously aware of RIB rate ⇒	2%	18%	39%	41%	100%	80%**
Not previously aware ⇒	3%	29%	28%	41%	100%	68%
Pay more for products that are environmentally friendly						
All Customers						
Previously aware of RIB rate ⇒	5%	37%	45%	13%	100%	58%
Not previously aware ⇒	5%	38%	39%	18%*	100%	57%
Low Income Customers						
Previously aware of RIB rate ⇒	5%	35%	43%	17%	100%	60%
Not previously aware ⇒	8%	33%	34%	25%	100%	59%

Row totals may not total 100% due to the rounding of values.
Not applicable and Don't Know responses have been excluded from all calculations.
* Statistically significant difference between the two groups' top-box score ('always') at the 95% level of confidence.
** Statistically significant difference between the two groups' top-two box score ('always' + 'usually') at the 95% level of confidence.

Customer Behaviour and Electricity Consumption by RIB Step 2 Price Alerts

BC Hydro's billing system shows that a total of 5 percent of customer households have signed up online to receive email notifications that indicate when their consumption of electricity is halfway to reaching the higher Step 2 price in a billing period, as well as when it has reached it. This incidence increased through each of the three consumption bins, having measured 2 percent among households that never incurred Step 2 electricity consumption in F2017, 6 percent among customers that sometimes incurred Step 2 consumption in that year and 7 percent among customers that always did so.

Table D.2.35: Incidence of Customers Signed-Up to Receive Step 2 Price Alerts

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total
Signed-up to receive Step 2 price alerts	2%	6%	7%	5%
Not signed-up	98%	94%	93%	95%
Total	100%	100%	100%	100%

Incidences ascertained from the customer account billing system.

Among customers in the 2017 survey that have signed up to receive the price alerts, 64 percent reported that they typically make more of an effort to manage their consumption of electricity when their household receives the price alerts – 35 percent do not.

At 52 percent, the majority of customers that always incurred Step 2 electricity consumption in F2017 reported that they do make more of an effort to manage their consumption when they receive the price alerts, but this proportion measured 14 to 17 points lower than the other two customer groups.

Table D.2.36: Effort in Managing Household Electricity Consumption When a Step 2 Price Alert Received

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total
Total much more of an effort + a little more of an effort	66%	69%	52%	64%
Much more of an effort	52%	30%	18%	29%
A little more of an effort	14%	39%	34%	35%
No change	34%	30%	45%	35%
A little less of an effort	0%	0%	0%	0%
Much less of an effort	0%	0%	0%	0%
Not Applicable – never received a Step 2 price alert	0%	1%	2%	1%
Total	100%	100%	100%	100%

Column totals may not total 100% due to the rounding of values.
Don't know responses have been excluded from all calculations.

Understanding the extent that the Step 2 price alerts assisted customers to manage their electricity consumption was difficult because these customers were among those with the highest consumption to begin with whereas others had comparably lower consumption. Such understanding was best ascertained by comparing the pool of customers who received and acted on the price alerts to a pool of customers that did not receive the alerts, but were nonetheless as similar as possible in other ways, especially in their Step 2 status.

Table D.2.37: ANOVA Tests: Mean Electricity Consumption in F2017 by Step 2 Price Alerts

	Received and acted on a Step 2 price alert (kWh)	All others (kWh)	Difference between groups (kWh)	F Statistic of Difference	Significance
Customers that were sometimes (1-11 months) or always into Step 2 (12 months)					
Total F2017 consumption ⇒	11,528	12,334	806	0.824	0.364
Total Step 1 consumption ⇒	7,137	7,219	82	0.378	0.539
Total Step 2 consumption ⇒	4,391	5,115	724	0.768	0.381
Customers that were always into Step 2 (12 months)					
Total F2017 consumption ⇒	17,885	18,520	635	0.159	0.690
Total Step 1 consumption ⇒	8,122	8,122	0	0.000	1.000
Total Step 2 consumption ⇒	9,763	10,398	635	0.159	0.690
Customers in single detached houses that were always into Step 2 (12 months)					
Total F2017 consumption ⇒	18,406	18,859	453	0.072	0.789
Total Step 1 consumption ⇒	8,122	8,122	0	0.000	1.000
Total Step 2 consumption ⇒	10,284	10,737	453	0.072	0.789

For households that chose to act on the Step 2 price alerts, various analyses showed – depending on the comparison scenario – that their Step 1 and/or Step 2 electricity consumption in F2017 was lower than other households. The differences were not statistically significant, however, largely because the absolute number of households in the survey that received the price alerts and acted on them was not large enough to afford a high level of confidence in the findings.

Extent that the RIB Rate was a Factor in Purchasing a Non-Electric Item

Customers aware of the RIB rate were asked if they had purchased any natural gas, oil or propane equipment or appliances in the past three years and, if they had done so, how much of a factor the rate was in their decision to purchase it as opposed to one powered by electricity.

Table D.2.38 details the purchase rates for the six non-electric items and for each, the extent that customers said the RIB rate was a factor in choosing non-electric type rather than one powered by electricity.

Table D.2.38: Extent that the RIB Rate was a Factor in Purchasing a Non-Electric Item in the Past Three Years - among customers previously aware of the RIB rate and who purchased the item –

		Extent that the RIB Rate was a factor in the purchase decision					
	Purchased	Don't know	No factor at all	Minor factor	Major factor	Total	Total major + minor factor
Gas/Propane Fireplace	4%	2%	38%	15%	46%	100%	61%
Gas/Oil Furnace	6%	<1%	40%	21%	39%	100%	60%
Gas Range/Cooktop	4%	1%	42%	22%	35%	100%	57%
Gas/Oil/Propane Water Heater	6%	1%	46%	18%	35%	100%	53%
Gas/Propane Patio Heater	3%	2%	46%	20%	33%	100%	53%
Gas Lawnmower	7%	0%	63%	18%	18%	100%	36%

Row totals may not total 100% due to the rounding of values.

D.2.7. Customer Support of a Flat Rate

To close out the section on rate structures in the 2017 survey, customer respondents were asked their opinion of a flat rate. The question was prefaced with a statement that BC Hydro may one day consider altering its method of charging customers for their consumption of electricity to address changes in energy policy and objectives. Customers were also reminded that under a flat rate, the price per kilowatt hour (kWh) of electricity is constant regardless of the amount of electricity used in a billing period.

A total of 33 percent of customers reported that they would support a flat rate, 20 percent would be indifferent towards it, and 38 percent would be opposed to it. At 44 percent, support for a flat rate measured highest among customers households who always incurred Step 2 electricity consumption in F2017.

Table D.2.39: Customer Support of a Flat Rate

	Never into Step 2 (0 months)	Sometimes into Step 2 (1-11 months)	Always into Step 2 (12 months)	Total
Total strongly support + somewhat support	22%	34%	44%	33%
Strongly support	8%	12%	19%	12%
Somewhat support	15%	22%	25%	21%
Indifferent	20%	20%	19%	20%
Somewhat oppose	25%	21%	18%	22%
Strongly oppose	24%	15%	8%	16%
Don't know	9%	10%	11%	10%
Total	100%	100%	100%	100%

Column totals may not total 100% due to the rounding of values.

Appendix E: Survey Instrument

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Survey ID: 000000
Pass Key: 000000

ATTN: <MAILING_NAME>
<MAILING_ADDRESS>
<MAILING_TOWN, PROVINCE, POSTAL>

IN REGARDS TO SERVICE ADDRESS:
<SERVICE_ADDRESS>
<SERVICE_TOWN>

July/August 2017

Dear Customer:

As per the invitation letter previously sent to your household, you have been selected at random from all BC Hydro customers to be part of this Residential Rate Survey. If you have already completed your survey on the Internet, then we thank you for doing so and you may discard this booklet.

New technologies, population increases, industrial growth and energy policies are all factors that determine how much electricity B.C. will need in the future. Understanding our residential customers' opinions about electricity and electricity rates also plays a role in this regard and as such, your participation in this survey is extremely important.

The Mustel Group, an independent research company based in B.C., is assisting us to conduct it. Your responses will be held in strict confidence by BC Hydro's Evaluation department and will be compiled with those of other customers for the research and planning purposes identified above.

Please ensure that your survey responses refer to the residence located at the service address as shown above. The survey should be completed by either the primary or joint account holder.

You may complete this printed survey and return it in the postage paid envelope provided or, alternatively, you may access the electronic version of the survey on the Internet by typing the website address below into a browser's address bar and using the survey ID and pass key shown at the top of this page.

The online survey has been optimized for completion on a smartphone, but completion on a computer or tablet – should you have one – will be made easier due to their larger screens and the survey's layout.

www.web-research-online.com/bchydro.html ⇐ type this address in; do not use a search engine.

Please complete the survey by August 18, 2017, and for doing so, you can enter your name in a draw for one of four $250 gift cards to a home improvement retailer of your choice. If you complete the survey on the Internet, your name will be entered in the draw one additional time. Also, if your completed survey is received (in the mail or submitted via the Internet) by August 8, your name will be entered in the draw one additional time.

Contact information is detailed on the inside cover of this booklet should you have any questions about how to complete the survey or why BC Hydro has commissioned it.

Thank you for your cooperation and prompt response. The information you provide is extremely important to us.

Yours truly,

Anthea Jubb

Anthea Jubb
Senior Regulatory Manager, Tariffs

Residential Rate Survey

You and your household have been randomly selected from all BC Hydro residential customers to participate in this Residential Rate Survey. Your participation in this survey and your accompanying opinions are very important because you will be representing – in effect – as many as 500 other customers who might be similar to you, but have not been randomly selected to participate.

Questions?

The Mustel Group, an independent research company based in B.C., is assisting us to conduct this survey. If you have any questions about how to complete or return your survey, please contact Matt Shepherd, Project Manager at mshepherd@mustelgroup.com or toll-free at 1-866-742-2242.

If you have questions about why BC Hydro is conducting this research, please contact Marc Pedersen, Senior Evaluation Specialist at marc.pedersen@bchydro.com.

Please complete and return the survey by August 18, 2017.

The information gathered in this survey is being collected in furtherance of BC Hydro's electricity conservation mandate under the *Clean Energy Act*.

In consideration of privacy issues, do not reference any individuals' names in your responses.

Thank you for your participation and prompt response.

BC Hydro
333 Dunsmuir Street, Vancouver BC V6B 5R3
www.bchydro.com

Important…

Work your way through the survey from front to back, carefully following the applicable instructions. By doing so, you may be instructed to skip past some of the questions not relevant to you and your household.

Managing Electricity Use

1. Customer households can manage their consumption of electricity by changing behaviour, purchasing energy-efficient products, making energy-efficient home upgrades or by participating in conservation programs.

Assuming you wanted to do so, how easy or difficult is it for your household to manage its consumption of electricity?

☐[1] Very easy
☐[2] Somewhat easy
☐[3] Somewhat difficult
☐[4] Very difficult

☐[99] Don't know

2. How much of an effort does your household currently make to manage its consumption of electricity?

☐[1] A great deal of effort
☐[2] A fair amount of effort
☐[3] A little effort
☐[4] No effort at all

☐[99] Don't know

☐[97] Not Applicable – there is little opportunity at this time to manage our household's consumption of electricity

3. Compared to three years ago, would you say your household is making more of an effort to manage its consumption of electricity, less of an effort, or has there been no change?

☐[1] Much more of an effort
☐[2] A little more of an effort
☐[3] No change
☐[4] A little less of an effort
☐[5] Much less of an effort

☐[99] Don't know

Electricity Prices

4. Please think about the amount of money your household pays for electricity every month, every two months, or even over the course of a year, and consider the benefits you receive in return.

Would you say that the amount of money your household pays for its consumption of electricity represents…

☐[1] Excellent value for money
☐[2] Good value for money
☐[3] Fair value for money
☐[4] Poor value for money
☐[5] Very poor value for money

☐[99] Don't know

5. Thinking of things in a slightly different way, would you say that BC Hydro's residential electricity prices are…

☐[1] Much too high
☐[2] Just a little too high
☐[3] About right
☐[4] Just a little too low
☐[5] Much too low

☐[99] Don't know

6. Compared to three years ago, do you think that BC Hydro's residential electricity prices have…

☐[1] Increased a great deal
☐[2] Increased just a little
☐[3] Stayed about the same
☐[4] Decreased just a little
☐[5] Decreased a great deal

☐[99] Don't know

7. Regardless of your household's current effort to manage its consumption of electricity, to what extent do BC Hydro's residential electricity prices serve as an incentive to your household to manage its consumption of electricity?

☐[1] Major incentive
☐[2] Minor incentive
☐[3] No incentive at all

☐[99] Don't know

Total Electricity Bill

8. How often do you look over your household's electricity bill (either the print version or the online version)?

☐[1] At least once a month
☐[2] Once every 2 months
☐[3] Once every 3 months
☐[4] Once every 4 to 6 months
☐[5] Once or twice a year
☐[6] Never – we just pay it

☐[99] Don't know/not sure

9. For the following set of statements, please check (✓) the response option that most accurately reflects your agreement or disagreement with the statement.

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Don't know
a. I spend more time looking over other bills I receive than my BC Hydro bill.	☐[1]	☐[2]	☐[3]	☐[4]	☐[5]	☐[99]
b. I have a good understanding of the factors that cause changes in my household's consumption of electricity.	☐[1]	☐[2]	☐[3]	☐[4]	☐[5]	☐[99]
c. My BC Hydro bill is easy to understand.	☐[1]	☐[2]	☐[3]	☐[4]	☐[5]	☐[99]
d. I usually pay my BC Hydro bill without looking over its consumption details.	☐[1]	☐[2]	☐[3]	☐[4]	☐[5]	☐[99]

10. Compared to three years ago, would you say the total dollar amount of your household's electricity bills have…

☐[1] Increased a great deal
☐[2] Increased just a little
☐[3] Stayed about the same ⇒ **check the box, then skip to question 12**
☐[4] Decreased just a little
☐[5] Decreased a great deal

☐[99] Don't know ⇒ **check the box, then skip to question 12**

11. Thinking about your response in question 10 above, which of the following statements do you believe describes the reason(s) for the change in the total dollar amount of your electricity bills over the past three years. (check all that apply)

☐[1] I believe the change in our bills has been due to changes in the overall price we pay for electricity.
☐[2] I believe the change in our bills has been due to changes in our consumption level.

☐[99] Don't know/not sure

☐[97] Not applicable – our electricity bills have 'stayed about the same' (your previous response to question 10)

12. Thinking of your own experience, to what extent does the total dollar amount of your electricity bills serve as an incentive to your household to manage its consumption of electricity?

☐[1] Major incentive
☐[2] Minor incentive
☐[3] No incentive at all

☐[99] Don't know

As a reminder…

- **Mail the completed survey in the postage paid envelope provided, or complete the electronic version by August 18.**
- **For completing your survey, you can enter your name into a draw for one of four $250 gift cards to the home improvement retailer of your choice.**
- **If you complete the survey online, your name will be entered in the draw one additional time. Also, if your survey is received (in the mail or submitted via the Internet) by August 8, your name will be entered in the draw one additional time.**
- **Official rules can be viewed online at: www.web-reseach-online.com/bchydro_rules.html**

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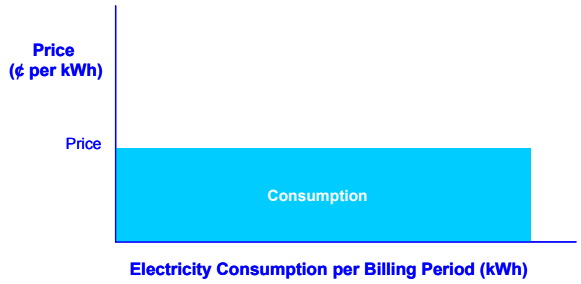
Rate Structures

In this section of the survey, we would like to explore your awareness and understanding of rate structures – that is, the various methods that can possibly be used to charge customers for their consumption of electricity, which is measured in kilowatt hours (kWh). Please review the four most common methods in the illustrations below.

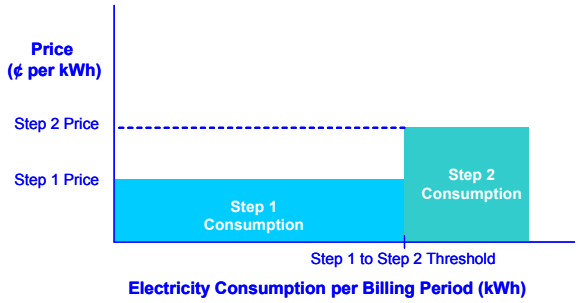
Flat Rate

1. **The price per kilowatt hour (kWh) of electricity is constant regardless of the amount of electricity used in a billing period.**



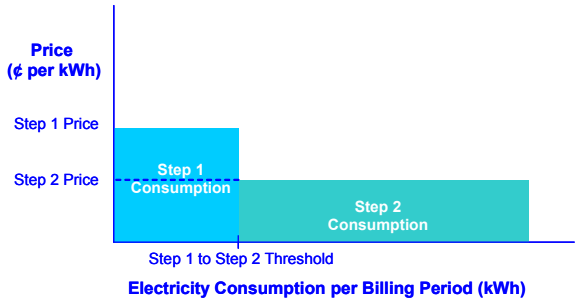
Inclining Block Rate / Stepped Rate

2. **The price per kilowatt hour (kWh) of electricity is lower for the first portion of electricity used, and steps up to a higher price for any additional consumption beyond a specified threshold in a billing period. The inclining block rate is also known as a stepped rate.**



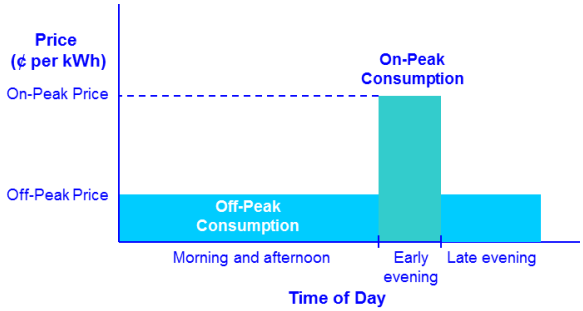
Declining Block Rate

3. **The price per kilowatt hour (kWh) of electricity is higher for the first portion of electricity used, and steps down to a lower price for any additional consumption beyond a specified threshold in a billing period.**



Time of Use Rate

4. **The price per kilowatt hour (kWh) of electricity varies by the time of day, typically higher during the early evenings than during all other hours of the day.**



You may review the explanation of rate structures and the accompanying illustrations on the adjacent page before proceeding with question 13.

13. Prior to receiving this survey, were you aware – in concept – of the flat rate method that can be used to charge customers for the consumption of electricity?

☐[1] Yes
☐[0] No

☐[99] Don't know

14. Prior to receiving this survey, were you aware – in concept – of the inclining block rate (also known as a stepped rate) that can be used to charge customers for the consumption of electricity?

☐[1] Yes
☐[0] No

☐[99] Don't know

15. Prior to receiving this survey, were you aware – in concept – of the declining block rate method that can be used to charge customers for the consumption of electricity?

☐[1] Yes
☐[0] No

☐[99] Don't know

16. Prior to receiving this survey, were you aware – in concept – of the time of use rate that can be used to charge customers for the consumption of electricity?

☐[1] Yes
☐[0] No

☐[99] Don't know

17. Prior to receiving this survey, which one of the four common methods did you believe BC Hydro currently uses for charging its residential customers for their consumption of electricity?

☐[1] Flat rate (the price per kilowatt hour (kWh) of electricity is constant regardless of the amount of electricity used in a billing period)

☐[2] Inclining block rate (also known as a stepped rate, the price per kilowatt hour (kWh) of electricity is lower for the first portion of electricity used, and steps up to a higher price for any additional consumption beyond a specified threshold in a billing period)

☐[3] Declining block rate – (the price per kilowatt hour (kWh) of electricity is higher for the first portion of electricity used, and steps down to a lower price for any additional consumption beyond a specified threshold in a billing period)

☐[4] Time of use rate – (the price per kilowatt hour (kWh) of electricity varies by the time of day, typically higher during the early evenings than during all other hours of the day)

☐[99] Don't know/not sure

18. Thinking about your response to question 17 above – the method you believe BC Hydro currently uses for charging its residential customers – to what extent does the method serve as an incentive to your household to manage its consumption of electricity?

☐[1] Major incentive
☐[2] Minor incentive
☐[3] No incentive at all

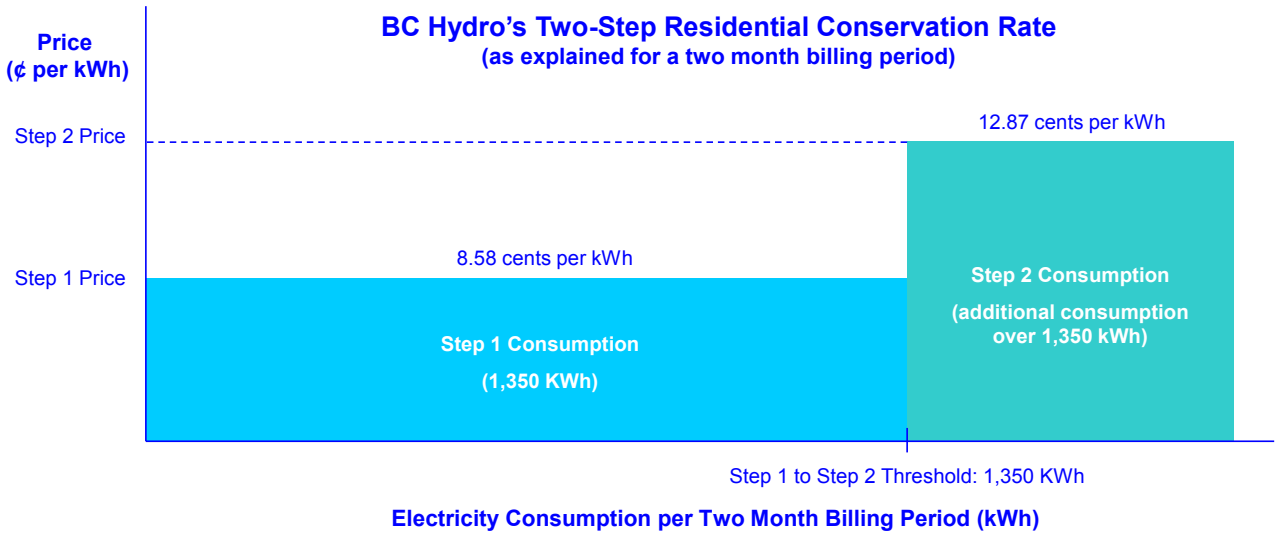
☐[99] Don't know

BC Hydro's Residential Rate Structure

The method that BC Hydro charges its residential customers for their consumption of electricity is an inclining block rate – also known as a stepped rate.

Under this rate structure, customers who are billed every two months currently pay 8.58 cents per kilowatt hour (kWh) for the first 1,350 kWh used. This first portion is called Step 1. Above that amount, these households pay 12.87 cents per kWh for the balance of the electricity used during the billing period. This second portion is called Step 2. For customers billed on a monthly basis, the Step 1 to Step 2 threshold is set at 675 kWh, but with the same prices in the billing period as noted above.

This rate structure is designed to encourage conservation and, as such, some customers may also know it as the Two-Step Residential Conservation Rate.



Please read about the Two-Step Residential Conservation Rate – as above – before proceeding with question 19.

19. Which of the following statements best describes your awareness of BC Hydro's method of charging its residential customers for their consumption of electricity?

☐[1] Prior to this survey, I was fully aware that residential electricity consumption is charged on a stepped rate (also known as an inclining block rate).

☐[2] Now that it has been mentioned, I had heard that residential electricity consumption is charged on a stepped rate (also known as an inclining block rate).

☐[3] Prior to this survey, my understanding was that residential electricity consumption is charged on a flat rate.

☐[4] Prior to this survey, my understanding was that residential electricity consumption is charged on a declining block rate.

☐[5] Prior to this survey, my understanding was that residential electricity consumption is charged on a time of use rate.

☐[6] Prior to this survey, I did not know how residential electricity consumption is charged.

☐[99] Don't know

20. Having read a little more about the stepped rate method that BC Hydro uses for charging residential electricity consumption, how easy or difficult would you say it is to understand how the rate works?

☐[1] Very easy
☐[2] Somewhat easy
☐[3] Somewhat difficult
☐[4] Very difficult

☐[99] Don't know

21. How much of an understanding would you say you actually had – prior to receiving this survey – about the stepped rate method that BC Hydro uses for charging its residential customers?

☐[1] Excellent understanding
☐[2] Good understanding
☐[3] Fair understanding
☐[4] Poor understanding
☐[5] Very poor understanding

☐[99] Don't know

☐[97] Not applicable – I was not previously aware of the stepped rate method that BC Hydro uses ⇒ **check the box, then skip to question 30**

22. Although your household is charged the Step 1 price for its consumption of electricity up to 1,350 kWh in a two-month billing period and the Step 2 price for any additional consumption, you may not necessarily think about the price of electricity in this way as it applies to your own household.

How do you think about the price of electricity as it applies to your own household? (check only one)

☐[1] I would say that I consider the lower, Step 1 price as being my household's price of electricity in a billing period.

☐[2] I would say that I consider the higher, Step 2 price as being my household's price of electricity in a billing period.

☐[3] I would say that I consider each of the Step 1 and Step 2 prices being my household's price of electricity, depending on the point in time in the billing period and/or our consumption in the billing period.

☐[4] I do not think about my household's price of electricity in any of these particular ways.

☐[99] Don't know

23. Thinking of your own experience, to what extent does the stepped rate that your household's electricity is charged serve as an incentive to your household to manage its consumption of electricity?

☐[1] Major incentive
☐[2] Minor incentive
☐[3] No incentive at all □ **check the box, then skip to question 25**

☐[99] Don't know □ **check the box, then skip to question 25**

24. Which one of the following statements/scenarios best describes how the stepped rate incents your household to manage its consumption of electricity? (check only one)

☐[1] The lower, Step 1 price on its own incents our household: I consider the lower, Step 1 price as being the price applicable to all our electricity consumption in a billing period, and we try to manage our consumption of electricity on that basis.

☐[2] The higher, Step 2 price on its own incents our household: I consider the higher, Step 2 price as being the price applicable to the part of electricity consumption in a billing period that we have control over, and we try to manage our consumption of electricity on that basis.

☐[3] The difference between the Step 1 and Step 2 prices incents our household: If we can manage our consumption of electricity effectively in a billing period, we can have most of it charged at the lower, Step 1 price, perhaps even avoiding Step 2 consumption and the higher, Step 2 price altogether.

☐[4] The consumption threshold on its own incents our household: Regardless of the difference in the Step 1 and 2 prices and the amount we pay on our bill, we compare our household's consumption to the Step 1 to Step 2 threshold (675 kWh for monthly billing; 1,350 kWh for bi-monthly billing) simply because we like to keep our consumption as low as possible compared to the threshold.

☐[5] The stepped rate does not incent my household to manage its consumption of electricity in any of these particular ways.

☐[99] Don't know

25. Compared to three years ago, would you say your household is more mindful of its consumption of electricity in relation to the Step 1 and Step 2 prices and thresholds, less mindful, or has there been no change?

☐[1] Much more mindful
☐[2] Somewhat more mindful
☐[3] No change
☐[4] Somewhat less mindful
☐[5] Much less mindful

☐[99] Don't know

26. Customers can sign-up online to receive email notifications that will indicate when their consumption of electricity is halfway to reaching the higher Step 2 price in a billing period as well as when it has reached it.

Which of the following reflects your awareness and use of these Step 2 price alerts?

☐[1] My household is currently signed-up to receive these alerts

☐[2] I was previously aware of these alerts, but have never signed-up to receive them □ **check the box, then skip to question 28**

☐[3] I was not previously aware of these alerts □ **check the box, then skip to question 28**

☐[99] Don't know □ **check the box, then skip to question 28**

27. When your household receives Step 2 price alerts, does it typically make more of an effort to manage its consumption of electricity, less of an effort, or is there typically no change in effort?

☐[1] Much more of an effort
☐[2] A little more of an effort
☐[3] No change
☐[4] A little less of an effort
☐[5] Much less of an effort

☐[99] Don't know

☐[97] Not Applicable – Our household has never received a Step 2 price alert

28. BC Hydro would like to understand if the stepped rate has been a factor in customer decisions to purchase any gas, oil or propane equipment/appliances instead of those that are powered by electricity.

For each gas, oil or propane equipment/appliance item listed, first indicate if your household has purchased one in the past three years. Next, for each item that you did purchase, indicate how much of a factor the stepped rate was – possibly, your desire to limit or avoid Step 2 electricity consumption – in your decision to purchase it as opposed to purchasing one powered by electricity.

If your household did not purchase any of the items, check here ( ), then skip to question 29.

			|-- The stepped rate was a … --|		
Purchased in the past 3 years?	**Yes, purchased**		**Major factor in the purchase decision**	**Minor factor in the purchase decision**	**No factor at all in the purchase decision**	**Don't know**
a. Gas, oil or propane furnace	☐[1]	⇒	☐[1]	☐[2]	☐[3]	☐[99]
b. Gas range and/or gas cooktop	☐[1]	⇒	☐[1]	☐[2]	☐[3]	☐[99]
c. Gas, oil or propane water heater	☐[1]	⇒	☐[1]	☐[2]	☐[3]	☐[99]
d. Gas or propane fireplace	☐[1]	⇒	☐[1]	☐[2]	☐[3]	☐[99]
e. Gas or propane patio heater	☐[1]	⇒	☐[1]	☐[2]	☐[3]	☐[99]
f. Gas lawn mower	☐[1]	⇒	☐[1]	☐[2]	☐[3]	☐[99]

29. Prior to receiving this survey, were you aware that the stepped rate is designed to encourage the conservation of electricity?

☐[1] Yes
☐[0] No

☐[99] Don't know

30. Even though you may have just learned about it, overall, would you say you generally support the stepped rate method that BC Hydro uses to charge its residential customers for their consumption of electricity, oppose it, or are you indifferent about it?

☐[1] Strongly support
☐[2] Somewhat support
☐[3] Indifferent
☐[4] Somewhat oppose
☐[5] Strongly oppose

☐[99] Don't know

31. Thinking about your response to question 30 above, for what reasons do you feel that way? (In consideration of privacy issues, please do not reference any individuals' names.)

32. Compared to three years ago, would you say you have become more supportive of the stepped rate, more opposed to it, or has there been no change in your opinion?

☐[1] Much more supportive of it
☐[2] Somewhat more supportive of it
☐[3] No change
☐[4] Somewhat more opposed to it
☐[5] Much more opposed to it

☐[99] Don't know

☐[97] Not Applicable – I was not aware of the stepped rate three years ago or was not previously aware at all

Other Rate Structures

33. To address any changes in energy policy and objectives, BC Hydro may one day consider altering its method of charging residential customers for their consumption of electricity.

One option might be changing from the stepped rate to a flat rate whereby the price per kilowatt hour (kWh) of electricity is constant regardless of the amount of electricity used in a billing period.

Would you say you would generally support a flat rate, oppose it, or are you indifferent about it?

☐[1] Strongly support
☐[2] Somewhat support
☐[3] Indifferent
☐[4] Somewhat oppose
☐[5] Strongly oppose

☐[99] Don't know

Current In-Home Behaviours

In this section, BC Hydro would like to understand your behaviours related to electricity use in this home.

Please check (✓) the response option that best describes what you normally do when you are at the property at the service address as shown on the cover page of this booklet.

However, if you own the property but rent it out to tenants, or if the property typically goes unoccupied such as a pump house, then complete this section in regards to your behaviours in the home that you personally live in.

Be sure to check (✓) the 'Not Applicable' box if the statement does not apply to your household.

34. Lighting Behaviours

	Always	Usually	Occasionally	Never	Not Applicable
a. Only have the minimum number of lights on in a room for what I am doing	☐1	☐2	☐3	☐4	☐97
b. Turn off lights when no one is in the room	☐1	☐2	☐3	☐4	☐97
c. Purchase the most energy-efficient light bulbs, even if they are more expensive	☐1	☐2	☐3	☐4	☐97

35. Space Heating Behaviours (during winter months)

Check the 'Not Applicable' box in row e if you do not have a dog or cat.

	Always	Usually	Occasionally	Never	Not Applicable
a. Use a communicating/programmable thermostat or manually turn down the heat at night	☐1	☐2	☐3	☐4	☐97
b. Use a communicating/programmable thermostat or manually turn down the heat when no one is home	☐1	☐2	☐3	☐4	☐97
c. Reduce temperature in unused rooms by closing vents or turning down thermostats	☐1	☐2	☐3	☐4	☐97
d. Dress more warmly in cold weather and reduce/keep the thermostat to 20° Celsius (68° Fahrenheit) or below	☐1	☐2	☐3	☐4	☐97
e. Maintain the temperature of your home specifically for your dog(s) or cat(s) when no one is home	☐1	☐2	☐3	☐4	☐97

36. Space Cooling Behaviours (during summer months)

If this home does not have air conditioning, check here ( ), then skip to question 37.

	Always	Usually	Occasionally	Never	Not Applicable
a. Have the air conditioning come on only when it is 26° Celsius (79° Fahrenheit) or higher during the summer to save energy	☐1	☐2	☐3	☐4	☐97
b. Draw the window coverings during hot weather to reduce heat in the dwelling	☐1	☐2	☐3	☐4	☐97
c. Clean the air conditioning filter and coils at least once per season	☐1	☐2	☐3	☐4	☐97
d. Cool only the rooms to be occupied rather than the whole home	☐1	☐2	☐3	☐4	☐97
e. Use air conditioning only when very hot and natural ventilation is insufficient	☐1	☐2	☐3	☐4	☐97

37. Please indicate the location of the laundry appliances that your household typically uses.

☐[1] In my own home
☐[2] In a laundry room in another part of my building (i.e., the laundry appliances are shared with other suites)
☐[3] In another building or at a laundry business

38. Laundry Behaviours (please complete the table below regardless of where you do your laundry)

	Always	Usually	Occasionally	Never	Not Applicable
a. Only do laundry with full loads	☐[1]	☐[2]	☐[3]	☐[4]	☐[97]
b. Use cold water wash & rinse when doing laundry	☐[1]	☐[2]	☐[3]	☐[4]	☐[97]
c. Clean the lint filter before drying clothes	☐[1]	☐[2]	☐[3]	☐[4]	☐[97]
d. Use the temperature/moisture sensor to turn off the dryer rather than use the timer	☐[1]	☐[2]	☐[3]	☐[4]	☐[97]
e. Hang clothes to dry rather than machine dry	☐[1]	☐[2]	☐[3]	☐[4]	☐[97]

39. Dishwasher Behaviours

If the home does not have an automatic dishwasher, check here ( ), then skip to question 40.

	Always	Usually	Occasionally	Never	Not Applicable
a. Only turn on the dishwasher when it is full	☐[1]	☐[2]	☐[3]	☐[4]	☐[97]
b. Air dry the dishes in the dishwasher rather than use the dry cycle	☐[1]	☐[2]	☐[3]	☐[4]	☐[97]

40. Water Use Behaviours

Check the 'Not Applicable' box in row 'a' if the home does not have its own water heater.

	Always	Usually	Occasionally	Never	Not Applicable
a. Turn off the water heater when no one is in the home for more than 2-3 days	☐[1]	☐[2]	☐[3]	☐[4]	☐[97]
b. Keep shower times to no more than 5 minutes each	☐[1]	☐[2]	☐[3]	☐[4]	☐[97]

41. Plug Load Behaviours

Check the 'Not Applicable' box if the home does not have the item.

	Always	Usually	Occasionally	Never	Not Applicable
a. Turn off the TV when no one is in the room or actively watching a program	☐[1]	☐[2]	☐[3]	☐[4]	☐[97]
b. Turn off the computer and printer when not in use OR use the power-save mode	☐[1]	☐[2]	☐[3]	☐[4]	☐[97]

42. How often do you perform the following actions?

	Always	Usually	Occasionally	Never	Not Applicable
a. Pay more for products that are environmentally friendly	☐[1]	☐[2]	☐[3]	☐[4]	☐[97]
b. Think about ways to save energy	☐[1]	☐[2]	☐[3]	☐[4]	☐[97]

Attitudes toward Electricity and the Environment

For the following sets of statements, please check (✓) the response option that most accurately reflects your agreement or disagreement with the statement.

43. This first set of statements relate to your awareness and opinion of energy conservation as an issue.

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Don't know
a.	I have a good understanding of the reasons given for conserving electricity in this province.	☐1	☐2	☐3	☐4	☐5	☐99
b.	I am in support of the reasons given for conserving electricity in this province.	☐1	☐2	☐3	☐4	☐5	☐99
c.	We could all use a lot less energy than we do and if many people conserved, we could all make a big difference overall.	☐1	☐2	☐3	☐4	☐5	☐99
d.	I am knowledgeable about ways to save electricity around my home.	☐1	☐2	☐3	☐4	☐5	☐99

44. These statements relate to your habits around electricity and conservation.

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Don't know
a.	I am an active energy conserver who looks for opportunities to save energy in everything I do.	☐1	☐2	☐3	☐4	☐5	☐99
b.	Conserving energy is second nature to me – I've always done it, and know how to do it.	☐1	☐2	☐3	☐4	☐5	☐99
c.	When I do make efforts to conserve electricity at home, it is more about saving money on my bill than helping to save the environment.	☐1	☐2	☐3	☐4	☐5	☐99
d.	By making my home more energy-efficient, I am helping to do my part for the environment.	☐1	☐2	☐3	☐4	☐5	☐99

45. These final four statements are a mixture of issues.

		Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree	Don't know
a.	Climate change is a serious problem.	☐1	☐2	☐3	☐4	☐5	☐99
b.	I really do <u>not</u> care much about energy and see little reason to conserve.	☐1	☐2	☐3	☐4	☐5	☐99
c.	I believe my household's usage of electricity is currently at or near its lowest possible level.	☐1	☐2	☐3	☐4	☐5	☐99
d.	Regardless of whether it makes a difference, everyone has a moral obligation to do the best they can to conserve energy.	☐1	☐2	☐3	☐4	☐5	☐99

Your Relationship to the Property

Important…

In these next sections of this survey, when we ask about your home, we are referring to the area covered by your BC Hydro bill at the service address as shown on the cover page of this booklet.

For some customers, this service address pertains to a seasonal home, a rental property or even an unoccupied structure such as a pump house rather than a primary residence. Whatever the case may be, please ensure your survey responses are in relation to the service address as shown on the cover page of this booklet.

46. Please indicate (✓) which of the following best describes your relationship to the property located at the service address as detailed on the cover page.

☐[1] I (co)own and live (full-time or part-time) in the property at this service address
☐[2] I (co)own and live in this Co-op property at this service address
☐[3] I (co)own the property at this service address, but rent it out to tenants
☐[4] I am a renter living in the property at this service address

☐[98] Other (please specify): _____

47. Regardless of whether it is owner or renter occupied, what type of residence is this property? (check only one)

☐[1] Primary residence
☐[2] Seasonal, vacation or weekend residence

☐[98] Other (please specify): _____

48. How many weeks or months in 2016 was this property left completely unoccupied?

_____ weeks OR _____ months **if 0 weeks unoccupied in 2016, then check this box:** ☐[0] 0 weeks

49. Who is the BC Hydro account holder associated with the property at the service address?

☐[1] Property owner(s)
☐[2] Renter(s)

☐[98] Other (please specify): _____

50. Do you (or your landlord) pay maintenance fees to a building management company or a strata corporation in regards to this property?

☐[1] Yes
☐[0] No

☐[99] Don't know

51. If you pay rent or maintenance fees, which of the following are included? (check all that apply)

☐[1] Heat
☐[2] Hot water
☐[3] Natural gas for fireplace
☐[4] Natural gas for cooking

☐[5] Rent or maintenance fees are paid in regards to this property, but none of these items are included

☐[97] Not Applicable – rent or maintenance fees are not paid in regards to this property

☐[99] Don't know

About the Home Structure

52. What type of home structure is this? (located at the service address as detailed on the cover page)

- ☐[1] Single detached house
- ☐[2] Duplex
- ☐[3] Row/townhouse (3 or more units attached, each with separate entrance)
- ☐[4] Apartment/condominium
- ☐[5] Mobile home/manufactured home

☐[98] Other (please specify): _____

53. When was this home built?

- ☐[1] Before 1950
- ☐[2] 1950-1975
- ☐[3] 1976-1985
- ☐[4] 1986-1995
- ☐[5] 1996-2005
- ☐[6] 2006-2015
- ☐[7] 2016-2017

☐[99] Don't know

54. What is the total floor area of this home? Include all floors covered by your BC Hydro bill, the basement and unfinished areas. Exclude the garage/carport and all other floors of apartment/condominium buildings.

_____ square feet OR _____ square meters ☐[99] Don't know

55. Does your BC Hydro bill cover only your household, or are there other households or suites on the same account?

- ☐[1] My household only
- ☐[2] Other households or suites as well ⇒ How many other households or suites? _____

56. Which of the following energy efficiency upgrades – if any – has your household completed at the service address in the last three years? (check all that apply)

- ☐[1] Door upgrades
- ☐[2] Draft proofing upgrades
- ☐[3] Insulation upgrades
- ☐[4] Window upgrades
- ☐[5] Air source heat pump installation/upgrade
- ☐[6] Ground source heat pump installation/upgrade
- ☐[7] Furnace installation/upgrade
- ☐[8] Hot water tank installation/upgrade

☐[98] Other (please specify): _____

☐[0] None of the above

☐[99] Don't know

Water Heating Equipment and Fuels

57. Please indicate (✓) the main type of hot water heating equipment in this home. (check only one)

If you live in an apartment or condominium, be sure to consider whether your water is heated by equipment in your own suite or by a central system located elsewhere in your building.

- ☐[1] Home does not have its own hot water equipment – the water is heated centrally elsewhere in the building and shared with other units
- ☐[2] Hot water tank (conventional storage tank)
- ☐[3] Heat pump water heater
- ☐[4] Tankless, on-demand water heater (not a small instant hot water dispenser in the kitchen)
- ☐[0] None – this property does not have access to running hot water
- ☐[99] Don't know

58. What is the main fuel used for the hot water heating equipment in this home?

- ☐[1] Electricity
- ☐[2] Natural gas
- ☐[3] Oil
- ☐[4] Wood
- ☐[5] Bottled or tanked propane
- ☐[6] Piped-in propane
- ☐[7] Solar

☐[98] Other (please specify): _____

☐[99] Don't know

☐[97] Not applicable – the home does not have its own hot water equipment

Home Heating Systems and Fuels

59. What is the main system used to heat the home at the service address? (check only one)

- ☐[1] Both central forced air furnace AND electric baseboards *
- ☐[2] Forced air furnace – single fuel
- ☐[3] Forced air furnace – dual fuel (without a heat pump)
- ☐[4] Forced air furnace – with a heat pump (all-in-one unit)
- ☐[5] Electric baseboard(s)
- ☐[6] Electric fireplace
- ☐[7] Electric radiant ceiling(s) or floor(s)
- ☐[8] Electric portable heaters (including ceramic, infrared)
- ☐[9] Electric wall heater(s)
- ☐[10] Heat pump – air source (not with all-in-one furnace)
- ☐[11] Heat pump – ground source (not with all-in-one furnace)
- ☐[12] Hot water baseboard(s)
- ☐[13] Hot water radiator(s)
- ☐[14] Hot water radiant floor(s)
- ☐[15] Natural gas fireplace
- ☐[16] Wood stove / wood fireplace

☐[98] Other (please specify): _____

☐[99] Don't know

* Typically these homes have central heat on the main floor and electric baseboards upstairs and/or downstairs.

60. In the first column in the grid below, please indicate the main heating fuel used with the main heating system you specified in question 59. In the second column, please indicate any other heating fuels used in the home.

- **If the home's main heating system is 'both a forced air furnace and electric baseboards', then the fuel used for the furnace should be indicated as the main heating fuel (in the 1st column), and electricity should be indicated as the other heating fuel for the electric baseboards (in the 2nd column).**
- **Note that hot water is not a fuel. We're interested in what fuel is used to heat the hot water.**

	Main Heating Fuel (check only one in this column) ⇓	**Other Heating Fuels** (check all that apply in this column) ⇓
Electricity	☐[1]	☐[1]
Natural gas	☐[2]	☐[2]
Oil	☐[3]	☐[3]
Wood	☐[4]	☐[4]
Bottled or tanked propane	☐[5]	☐[5]
Piped-in propane	☐[6]	☐[6]
District energy fuel(s) (produced by municipality)	☐[7]	☐[7]
Other (please specify):_____	☐[98]	☐[98]
No Other Fuels (home has only one fuel)		☐[0]
Don't know	☐[99]	☐[99]

You and Your Household

The collection of demographic information in this section serves two very important purposes. First, it assists us in determining the extent that the sample of completed surveys provides a representative cross-section of all residential customers. Second, the information allows a better understanding of how awareness levels, opinions and behaviours differ among certain groups of customers.

61. Your age is:

☐[1] 18 to 24 years of age
☐[2] 25 to 34
☐[3] 35 to 44
☐[4] 45 to 54
☐[5] 55 to 64
☐[6] 65 or older

62. You are:

☐[1] Female
☐[2] Male

63. Your education is:

☐[1] Less than Grade 12
☐[2] High school diploma
☐[3] Some college, vocational or technical school
☐[4] College, vocational or technical school graduate
☐[5] Some university
☐[6] University/graduate degree

64. Which of the following describe your current status? (check all that apply)

☐[1] Employed/self-employed – full-time
☐[2] Employed/self-employed – part-time
☐[3] Homemaker
☐[4] Retired
☐[5] Unemployed
☐[6] Student
☐[7] Short-term or long-term disability

☐[98] Other (please specify): _____

65. Please indicate the number of people living in this household on a full-time basis, in the following age categories. Please include any boarders or renters who do not have a separate BC Hydro account.

If the service address on the cover page pertains to a seasonal dwelling, then complete the table below in relation to the time(s) of the year when the dwelling is typically occupied.

	Number of people
a. Children 0 - 5 years of age	_____
b. Children 6 - 12	_____
c. Young adults 13 - 24	_____
d. Adults 25 - 64	_____
e. Adults 65 or older	_____
f. Total	= _____

66. Please indicate the combined total income before taxes for your household in the last year. The reason we ask is that, in analyzing groups of customers, we often find that energy use is related to total household income.

Your income information will never be associated with your name or household in any analysis or reporting.

☐[1] Under $20,000
☐[2] $20,000 to under $30,000
☐[3] $30,000 to under $40,000
☐[4] $40,000 to under $50,000
☐[5] $50,000 to under $60,000
☐[6] $60,000 to under $70,000
☐[7] $70,000 to under $80,000
☐[8] $80,000 to under $90,000
☐[9] $90,000 to under $100,000
☐[10] $100,000 to under $110,000
☐[11] $110,000 to under $120,000
☐[12] $120,000 or over

☐[99] Prefer not to say

67. Do you or anyone in your household use the property at the service address for farm use where income is generated from agricultural production (crops and/or livestock)?

☐[1] Yes ⇒ If Yes: Is your property at this service address assessed as a farm for tax purposes? ☐[1] Yes ☐[0] No
☐[0] No

68. Does anyone in your household conduct business activities in the home either on a full-time or part-time basis?

☐[1] Yes, full-time
☐[2] Yes, part-time
} If Yes: How many hours per week are business activities conducted in the home? ____ hours

☐[0] No

Suggestions?

69. Is there anything BC Hydro can do to make the Two-Step Residential Conservation Rate more effective in encouraging your household to manage its consumption of electricity efficiently and to conserve? (In consideration of privacy issues, please do not reference any individuals' names.)

Permission for Linkage to Account Consumption

70. A key objective of this survey is to collect the necessary information to assist in our evaluation of the Two-Step Conservation Rate, including how customers' consumption of electricity may vary with their awareness, understanding and attitudes toward the rate.

To facilitate this, it is important to analyze customers' consumption of electricity at their current address for the past year as well as the next year as a 'time series' of consumption data helps us to better control for year-to-year changes in the weather, the economy, etc.

Rather than asking you to estimate how much electricity your home has and will consume over these periods, BC Hydro's Evaluation department would like to access this information from your account history and link it to your responses in this survey. We will <u>not</u> access nor review any of your bill payment information.

☐[1] Yes
☐[0] No

Incentive Prize Draw

71. Please provide your name and contact information below if you wish to be entered into the draw for one of four $250 gift cards to a home improvement retailer of your choice.

You can view the official rules and regulations at www.web-reseach-online.com/bchydro_rules.html

	Name:	**Telephone:**	**Email Address:**
☐[1] Yes ⇒	_____	_____	_____
☐[0] No thanks			

Thank You!

Your time and effort in completing this survey is very much appreciated and will help in planning electricity services for your community and the province as a whole.

If you completed this survey in this booklet rather than online, please fold it in half and place it in the postage paid business reply envelope provided. Upon receiving your survey booklet via Canada Post, the Mustel Group will keypunch and compile your responses with those of other customers.

BC Hydro Power smart

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